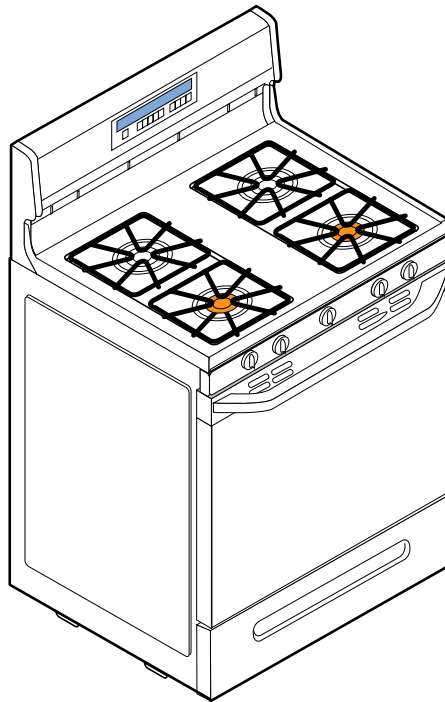




Service Professional Seminar



GAS RANGES

WARNING

Electrical Shock Hazard

Disconnect the gas range's line cord plug from the wall receptacle before you service any of the components inside the unit. Failure to do this could result in violent electrical shock.

VOLTAGE CHECKS

When making voltage checks, be sure to observe the following precautions:

1. The floor must be dry. Water and dampness increase the chances of electrical shock.
2. Set the voltmeter correctly for the voltage being measured.
3. Touch only the insulated parts of the meter probes.
4. Touch the component terminals, or wires, with the meter probe tips only.
5. Touch the meter probe tips only on the terminals being checked. Touching other components could damage good parts.

PARTS QUALITY

An important step in the appliance repair procedure is the selection of FSP® (FACTORY SPECIFICATION PARTS) as replacements. Use of “fits-all,” or “look alike” parts could result in early parts failure, safety hazard, or substandard performance of a WHIRLPOOL appliance. It could also result in an unnecessary repeat of your repair efforts.

To be sure that the part(s) you purchase meet the exacting quality standards used to build every new WHIRLPOOL appliance, be sure to ask for genuine FSP replacement parts, as specified for your model. “FSP” is a registered trademark of WHIRLPOOL CORPORATION.

You can buy your genuine FSP replacement parts from any authorized WHIRLPOOL Parts Distributor.

WHIRLPOOL CORPORATION assumes no responsibility for any repair made on our products by anyone other than qualified TECH-CARE® Service Technicians.

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INTRODUCTION

This program is designed to teach the servicer basic skills in handling common service procedures for gas ranges. This program does not cover the diagnosis and repair of all range problems and components, (oven liner, wiring harness, etc.).

PROGRAM OBJECTIVE

Upon completion of this program, the participants will be able to identify the location of major range components, as well as diagnose problems, and remove and repair the components causing the problem.

INSTRUCTIONS

This program has the following sections:

- Fundamental Properties of Gas
- Pressure Regulators
- The Cooktop Burner System
- The Oven Burner System
- Natural And L.P. Gas Conversion
- Testing The Components

TOOLS YOU WILL NEED

Phillips Screwdriver

Long-Nosed Pliers

Adjustable Wrench

Pipe Sealer

Special Tools:

- Volt-Ohmmeter

— NOTES —

FUNDAMENTAL PROPERTIES OF GAS

MEASURING HEAT ENERGY

When burning a gas fuel, heat energy is produced. This heat energy is usually expressed in British Thermal Units, or B.T.U.'s. One B.T.U. is equal to the amount of heat needed to raise one pound of water one degree Fahrenheit (see Figure 1-1).

1 B.T.U. = the heat necessary to raise 1 lb. of water 1°F

A wooden kitchen match will produce approximately 1 B.T.U. of heat energy.

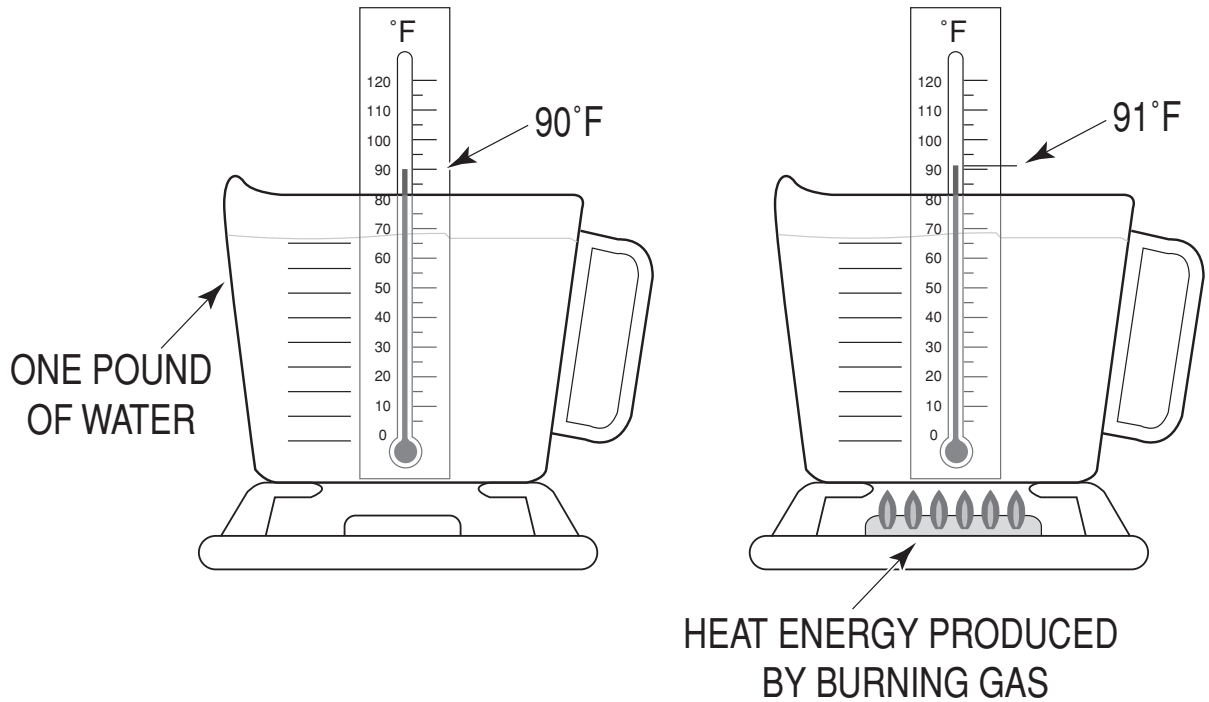


Figure 1-1

FUEL TYPES

Gas Fuels are categorized as follows:

- #1 = Natural Gas
- #2 = Mixed Gas
- #3 = Manufactured Gas
- #4 = Liquefied Petroleum Gas

#1 — NATURAL GAS

Natural Gas is found underground. It is referred to as “wet gas,” because it contains heavy hydrocarbons, such as propane and butane. These hydrocarbons are removed by the gas company so that only the pure natural gas properties, methane and ethane, are left.

Natural gas is lighter than air, and has a heat value of between 900 and 1200 B.T.U. per-cubic-foot.

#2 — MIXED GAS

Mixed Gas consists of natural and manufactured gas. It is lighter than air, and has a heat value of between 700 and 900 B.T.U. per-cubic-foot.

#3 — MANUFACTURED GAS

Manufactured Gas is made from coal and petroleum. It is lighter than air, and has a heat value of between 500 and 700 B.T.U. per-cubic-foot.

#4 — LIQUEFIED PETROLEUM (L.P.) GAS

Liquefied Petroleum (L.P.) Gas consists of the heavy hydrocarbons “propane or butane.” Both of these gases are converted from a **gaseous** to a **liquid** state by using pressure. The liquid gas can then be stored in a pressurized tank and easily transported. The liquid gas will return to its gaseous state when it is released into the atmosphere. L.P. gas is heavier than air and will lay in the lowest spot it can find when released into a room.

Propane has a heat value of 2500 B.T.U. per-cubic-foot, and **butane** a value of 3200 B.T.U. per-cubic-foot.

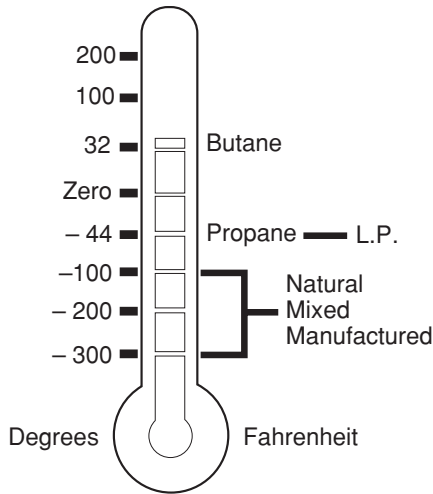
<p style="text-align: center;"><i>Category 1</i></p> <p style="text-align: center;">– Natural Gas –</p> <p style="text-align: center;">Contains Methane & Ethane. Sour Natural Gas Contains Hydrogen Sulfide Which Corrodes Copper & Brass. It Has A Heat Valve Of 900 to 1200 B.T.U. Per-Cubic-Foot. Specific Gravity Is 0.65 To 0.70.</p>	<p style="text-align: center;"><i>Category 2</i></p> <p style="text-align: center;">– Mixed Gas –</p> <p style="text-align: center;">Contains A Mixture Of Natural & Manufactured Gases. It Has A Heat Valve Of 700 to 900 B.T.U. Per-Cubic-Foot. Specific Gravity Is 0.5.</p>
<p style="text-align: center;"><i>Category 3</i></p> <p style="text-align: center;">– Manufactured Gas –</p> <p style="text-align: center;">Made From Coal & Petroleum. It Has A Heat Valve Of 500 to 700 B.T.U. Per-Cubic-Foot. Specific Gravity Is 0.38 To 0.40.</p>	<p style="text-align: center;"><i>Category 4</i></p> <p style="text-align: center;">– Liquefied Petroleum (L.P.) Gas –</p> <p style="text-align: center;">Made Of Propane Or Butane. Is Converted To A Liquid State Under Moderate Pressure For Easy Transportation In Pressurized Tanks. Propane Has A Heat Valve Of 2500 B.T.U. Per-Cubic-Foot. Specific Gravity Is 1.53.</p>

Gas Fuel Properties Summary

CHARACTERISTICS OF GAS FUELS

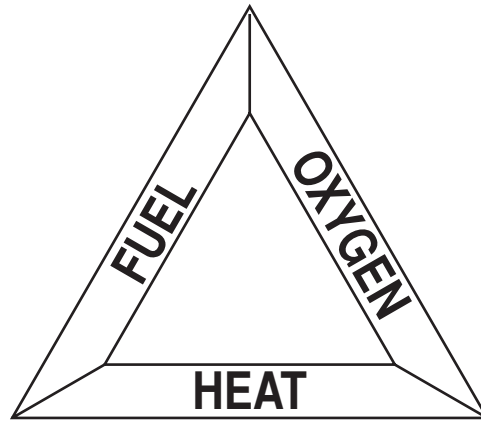
Each of the four types of gas has a specific boiling point (see Figure 1-2). The **boiling point** is referred to as the temperature where gas turns from a liquid to a gas at atmospheric pressure. If temperatures fall below the freezing point (32°F), the liquid will not turn into a gas, and there will be no flame.

By itself, gas cannot be ignited. Fuel, oxygen, and heat are necessary for combustion to occur. Remove one of these, and combustion cannot take place (see Figure 1-3).



BOILING POINT OF GAS

Figure 1-2



THE COMBUSTION PROPERTIES

Figure 1-3

Gases will ignite at temperatures between 900°F and 1200°F.

A proper mixture, or ratio, of gas and air is needed to produce a flame. If the air-to-gas ratio is not correct, incomplete combustion, or an improper flame, will result. The ratio needed to ignite natural gas (10:1) is shown in Figure 1-4, and the ratio for L.P. gas (24:1) is shown in Figure 1-5.

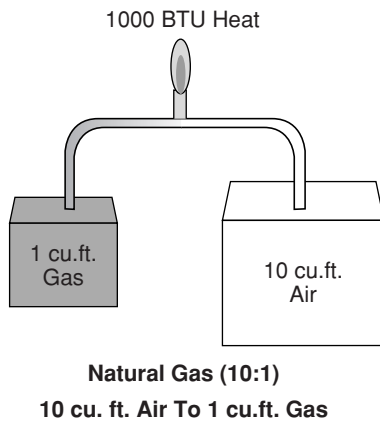


Figure 1-4

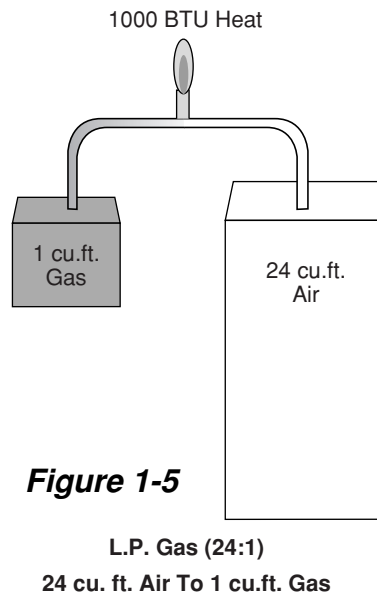


Figure 1-5

DISTRIBUTION OF NATURAL GAS

Utility companies send natural gas through underground pipes, called “mains.” The gas in these mains is pressurized at between 25 and 60 pounds-per-square-inch (psi).

Branches carry the pressurized gas to the various buildings, and are connected to gas meters. The meters decrease the main’s gas pressure to 7 inches water column pressure (1/4 pounds) for use by the appliances inside the buildings (see Figure 1-6).

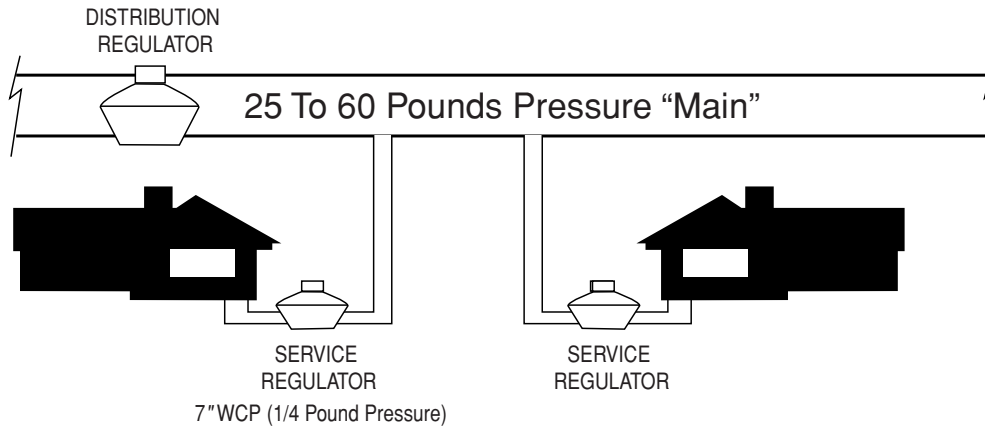


Figure 1-6

A gas piping system is able to supply gas to all of the appliances in a building at one time. Ranges generally operate on gas pressure rated at 4 inches water column pressure. Each appliance usually has its own pressure regulator to more accurately meet the designed requirements (see Figure 1-7).

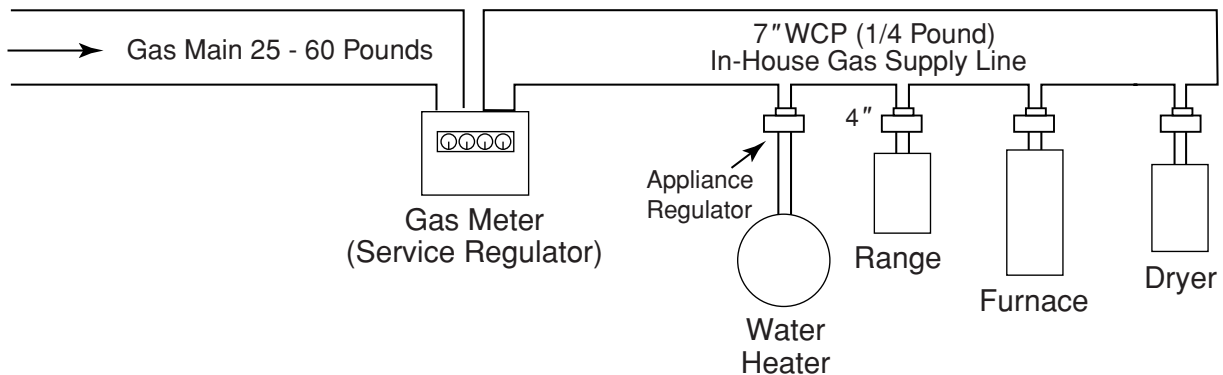


Figure 1-7

DISTRIBUTION OF L.P. GAS

For Liquid Propane (L.P.) gas, appliances generally operate on gas pressure rated at between 10 and 12 inches water column pressure. Each appliance usually has its own pressure regulator to more accurately meet the designed requirements (see Figure 1-8).

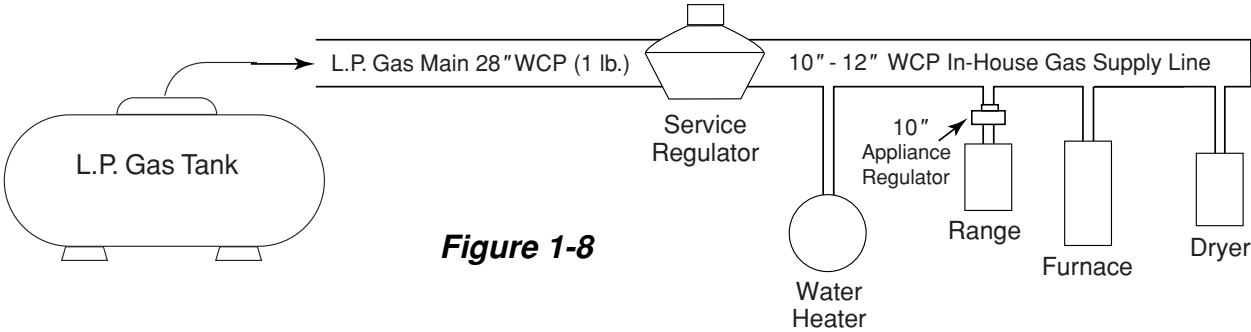


Figure 1-8

PRESSURE REGULATORS

FUNCTIONS

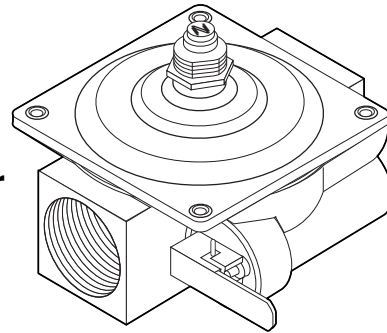
A **Gas Pressure Regulator** is a mechanical device that performs the following two functions:

- Reduces higher incoming gas pressure to a desired lower outgoing gas pressure.
- Maintains a steady, even flow of gas as it leaves the regulator.

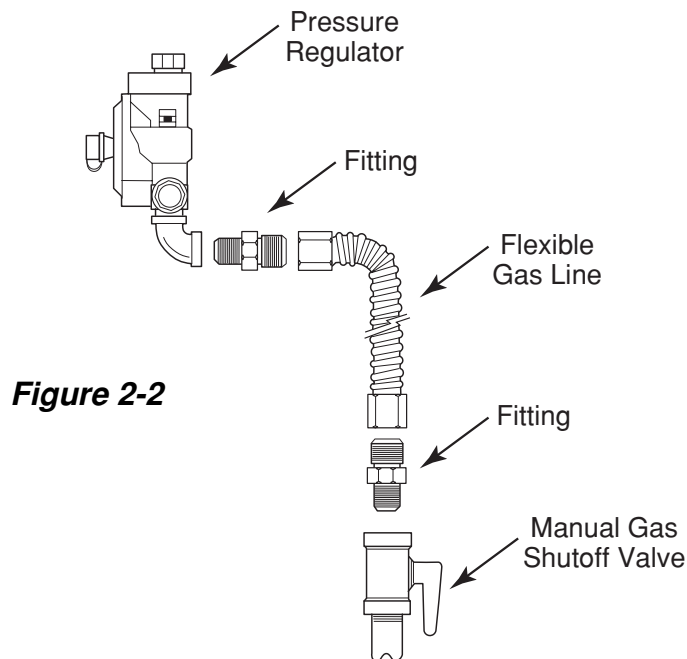
The **Appliance Pressure Regulator** is used to further reduce the gas pressure to the desired level for the particular application (see Figure 2-1). This is the final stage of gas regulation. It controls gas at a lower pressure and flow rate.

Appliance Pressure Regulator

Figure 2-1



It is recommended that the pressure regulator be connected to a manual gas shutoff valve, via a flexible line (depending on local codes), so that it will be easy to shut off the gas supply to the range before servicing it (see Figure 2-2).



REGULATOR OPERATION

The pressure of the gas coming into the pressure regulator pushes against a spring-loaded diaphragm, forcing it upward. The diaphragm spring puts pressure on the diaphragm. In order to control the flow rate, the diaphragm has a tapered plug suspended from it to restrict or increase the gas flow pressure (see Figure 2-3).

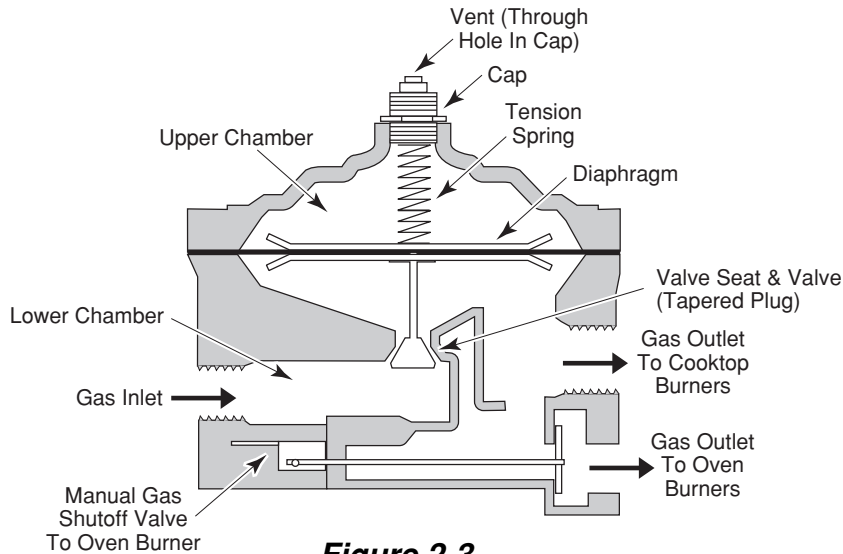


Figure 2-3

As the gas pressure against the diaphragm drops, the tension from the spring pushes the diaphragm downward, moving the tapered plug away from the valve seat, allowing more gas pressure to flow to the burners (see Figure 2-4). Additional gas may then flow into the regulator, pushing the diaphragm back up, thus restricting the flow of gas pressure into the passage way, and the cycle can repeat. In this way, the diaphragm and tapered plug maintain a constant gas pressure level to the burners.

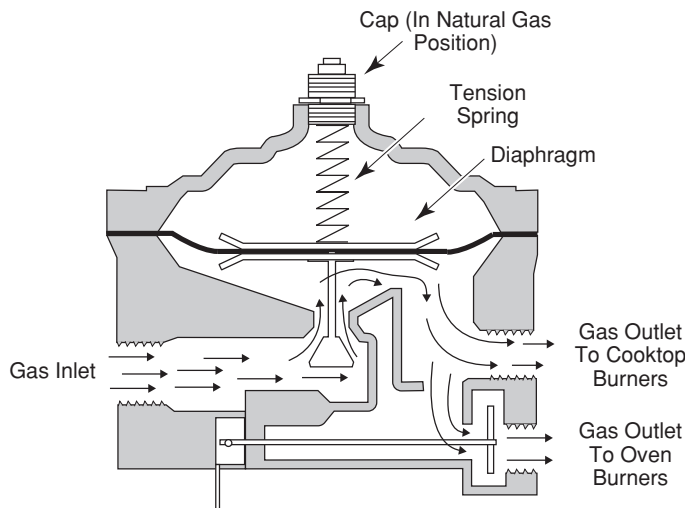


Figure 2-4

The amount of spring tension applied to the diaphragm determines the output pressure of the regulator (see Figure 2-5).

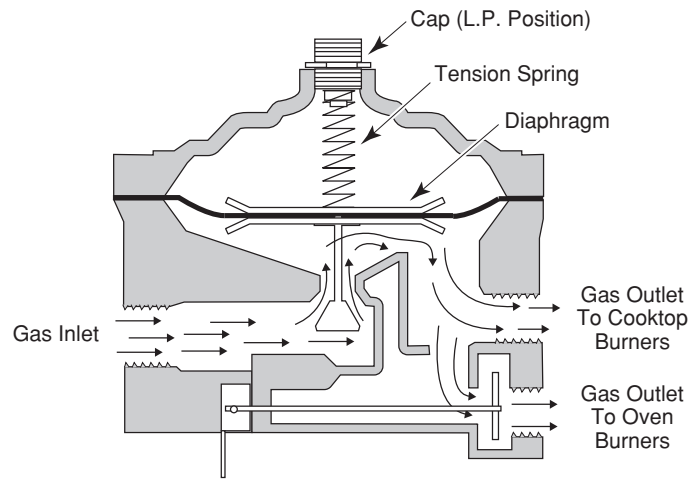


Figure 2-5

A manual gas shutoff on some pressure regulators will allow the gas to be turned off to the oven burners during service to allow gas flow to the cooktop to remain on. The gas to the oven burners is turned off by moving the manual shutoff lever in the direction shown in Figure 2-6.

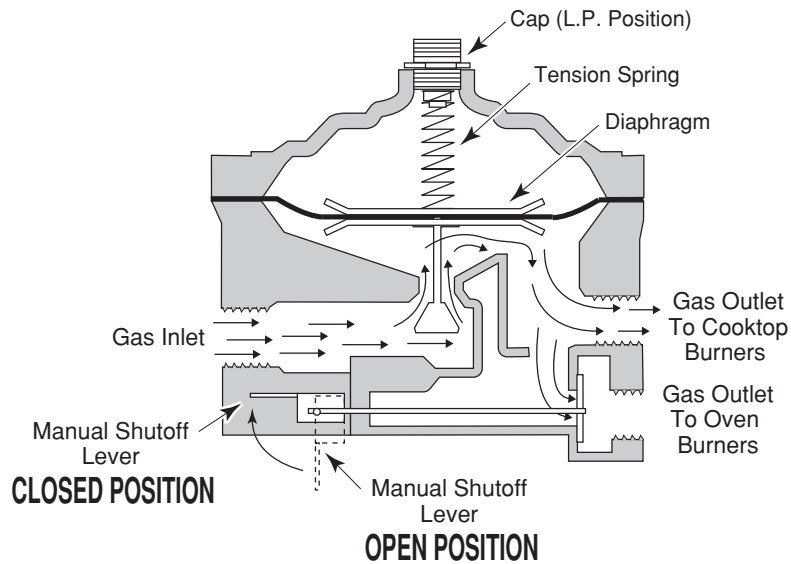


Figure 2-6

VENTING

Pressure regulators contain an air vent in the upper chamber to allow a free flow of air in and out of the chamber during operation (see Figure 2-7). The vent's secondary purpose is to safely control the flow of gas to the atmosphere (200cc-per-hour or 7 BTU-per-hour) in case the diaphragm ruptures. If the vent is partially or completely plugged, the regulator will become sluggish. It can also become fixed in the high or low position, depending on which position the diaphragm was in when it became plugged.

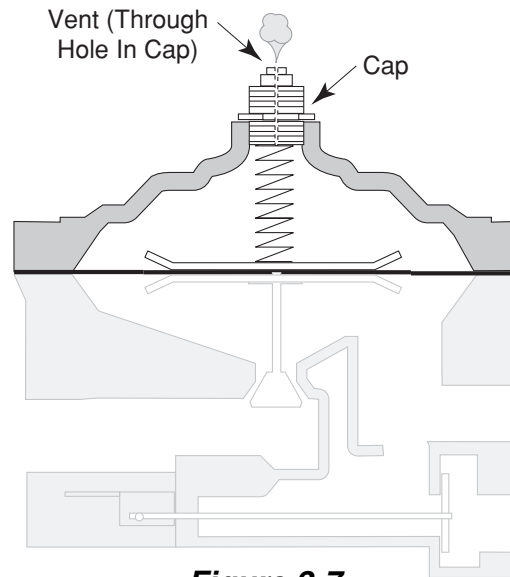


Figure 2-7

REGULATOR DIAGNOSTICS

Common causes for regulator failure are:

- A. Ruptured diaphragm.
- B. Broken or worn valve.
- C. Debris accumulating around the valve seat.
- D. Restricted (plugged) vent.
- E. Internal corrosion due to water in the L.P. gas system. Keep the tank full to prevent this from occurring.

As a safety feature, the regulator will “lock-up” and restrict all gas flow during any situation that applies extreme pressure to the incoming gas supply line. The pressure regulator can be unlocked by removing the cap, and pushing down on the diaphragm with the eraser end of a pencil.

Usually the appliance regulator is replaced rather than serviced, since it has few replaceable or serviceable parts, and is a relatively inexpensive device.

MEASURING GAS PRESSURE

Gas pressure is measured in **Inches of Water Column Pressure (WCP)**. It takes 28" WCP to equal one pound per-square-inch (PSI).

In most locations, natural gas pressure entering the home is regulated to 7 inches water column. L.P. gas is regulated between 10 and 12 inches water column. The appliance regulator reduces the incoming pressure to the required amount for the appliance. The model/serial plate on the gas range (see Figure 2-8) provides information about the proper water column pressure. Whirlpool ranges operate on 4 inches water column on natural gas, and 10 inches WCP on L.P.

it becomes necessary to measure these pressures, two instruments are available: a manometer, and a magnehelic gauge.

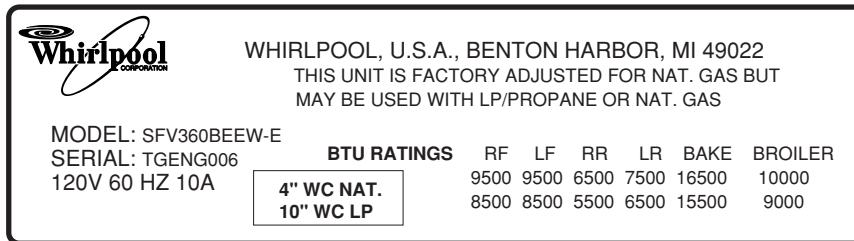


Figure 2-8

When it becomes necessary to measure these pressures, there are two instruments available that you can use: a manometer and a magnehelic gauge.

A manometer is basically a U-shaped tube with a scale, marked in inches of water column. To prepare and use the manometer, use the following steps:

1. Check the appliance model/serial plate and note the gas pressure rating.
2. Turn off the gas pressure to the range.
3. Prepare the manometer by filling the U-shaped tube with water so that both sides of the tube fill to the **zero** point (see Figure 2-9). NOTE: Use a little food coloring in the water to help make reading the meter easier.
4. Connect the tubing that is supplied with the manometer over one end of the manometer.
5. Remove a burner from the appliance and place the free end of the tubing over the burner orifice.
6. Turn on the gas supply to the range.
7. Turn on the gas valve to the orifice being tested and light at least one other burner to serve as a load.

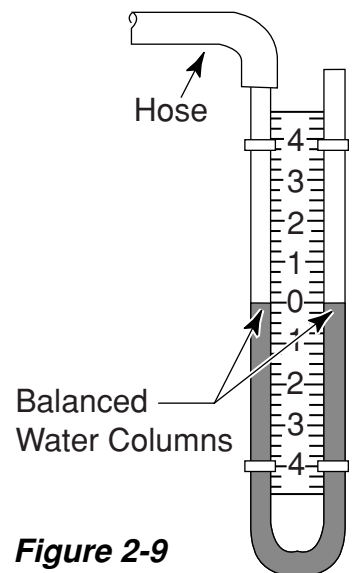
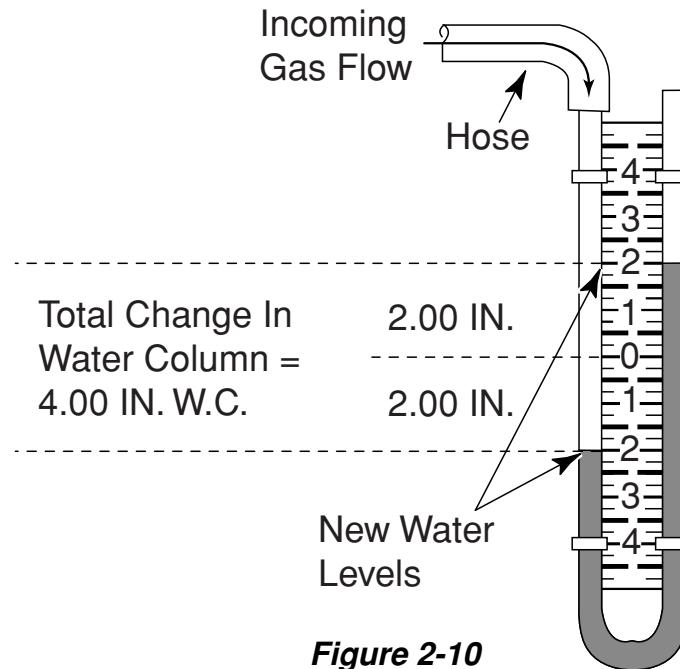


Figure 2-9

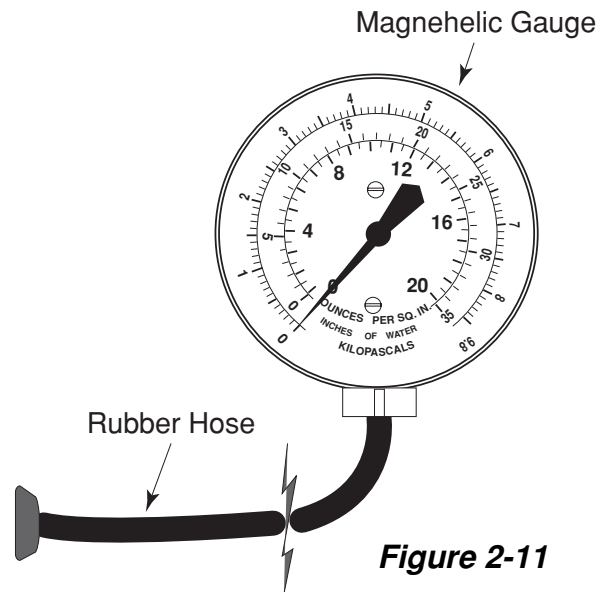
8. Observe the movement of the water in the manometer. The gas pressure is read by adding the water movement in both legs of the tube, as shown in Figure 2-10. It should measure within the pressure rating stated on the rating plate.



The Magnehelic gauge (see Figure 2-11) can also help measure gas pressure. This type of gauge is easier and faster to use than a manometer.

To use the gauge:

1. Check the appliance model/serial plate and note the gas pressure rating (see Figure 2-8 on the previous page).
2. Turn off the gas pressure to the range.
3. Remove a burner from the appliance and place the free end of the tubing over the burner orifice.
4. Turn on the gas supply to the range.
5. Read the gas pressure directly from the scale of the gauge. It should measure within the pressure rating stated on the rating plate. Some gauges have numerous scales on the dial face. Read the water column pressure scale when taking the measurement.



THE COOKTOP BURNER SYSTEM

GAS DISTRIBUTION

After gas passes through the gas pressure regulator, it enters the gas manifold for distribution to the cooktop burners, or the oven safety valve. The components that provide the safe distribution and operation of the cooktop burner system (see Figure 3-1) will be discussed in this section.

GAS MANIFOLD—After gas passes through the appliance gas pressure regulator, it enters a manifold. A manifold is simply a formed pipe through which the incoming gas is distributed to each of the burner valves.

GAS VALVE—The gas valve controls the gas flow to the individual burners. The valves on all Whirlpool ranges are push-to-turn types to keep them from being turned on accidentally. When the valve is turned on, gas flows through the valve and out an orifice.

ORIFICE—The orifice is a special fitting at the outlet of the valve that controls the amount of gas released through the valve. The orifice controls the gas flow and directs it into the venturi and air shutter assembly.

AIR SHUTTER & VENTURI—From the orifice, the gas flows through an air shutter into the venturi, and finally to the burner head, where it exits a series of small holes, called “ports,” and is ignited by the pilot flame, or spark.

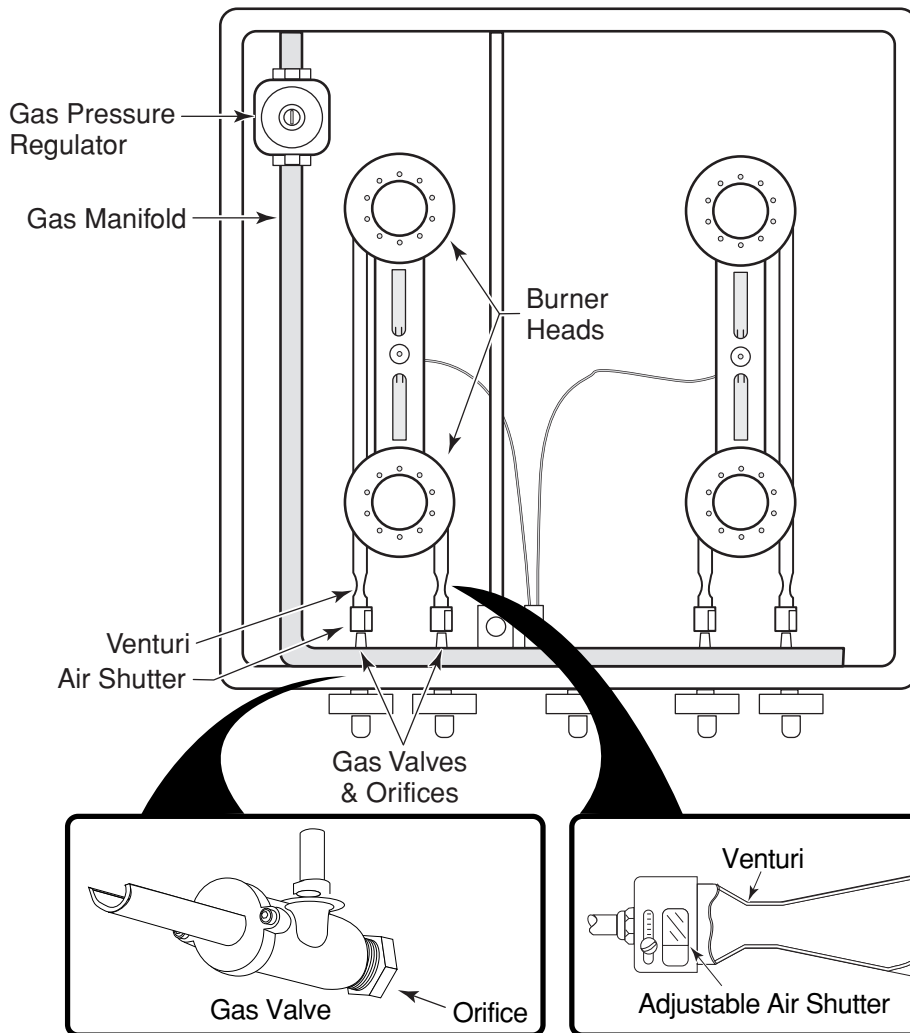


Figure 3-1

GAS VALVE

A typical Whirlpool gas valve and its component breakdown is shown in Figure 3-2. The gas valves are used to control the gas flow to the top burners. The gas valves are usually mounted to the top of the manifold pipe with a screw and rubber washer. The gas valve housing contains a hollow gas control seat. As the valve stem is rotated, the hole in the seat rotates to align with the hole in the top of the valve housing (see Figure 3-3). Gas from the manifold then flows through the holes to the orifice.

There are two types of gas valves used, depending on the model of the range. The first type of valve goes from closed to completely open by manually rotating the valve stem from 0° to 90°. The second type of valve has a stem rotation of 220°.

The 220° gas valve has a **low flame adjustment screw** that is located inside the shaft of the valve stem (see Figure 3-4). To adjust the control, use a small screwdriver, and turn the control until the desired flame is produced.

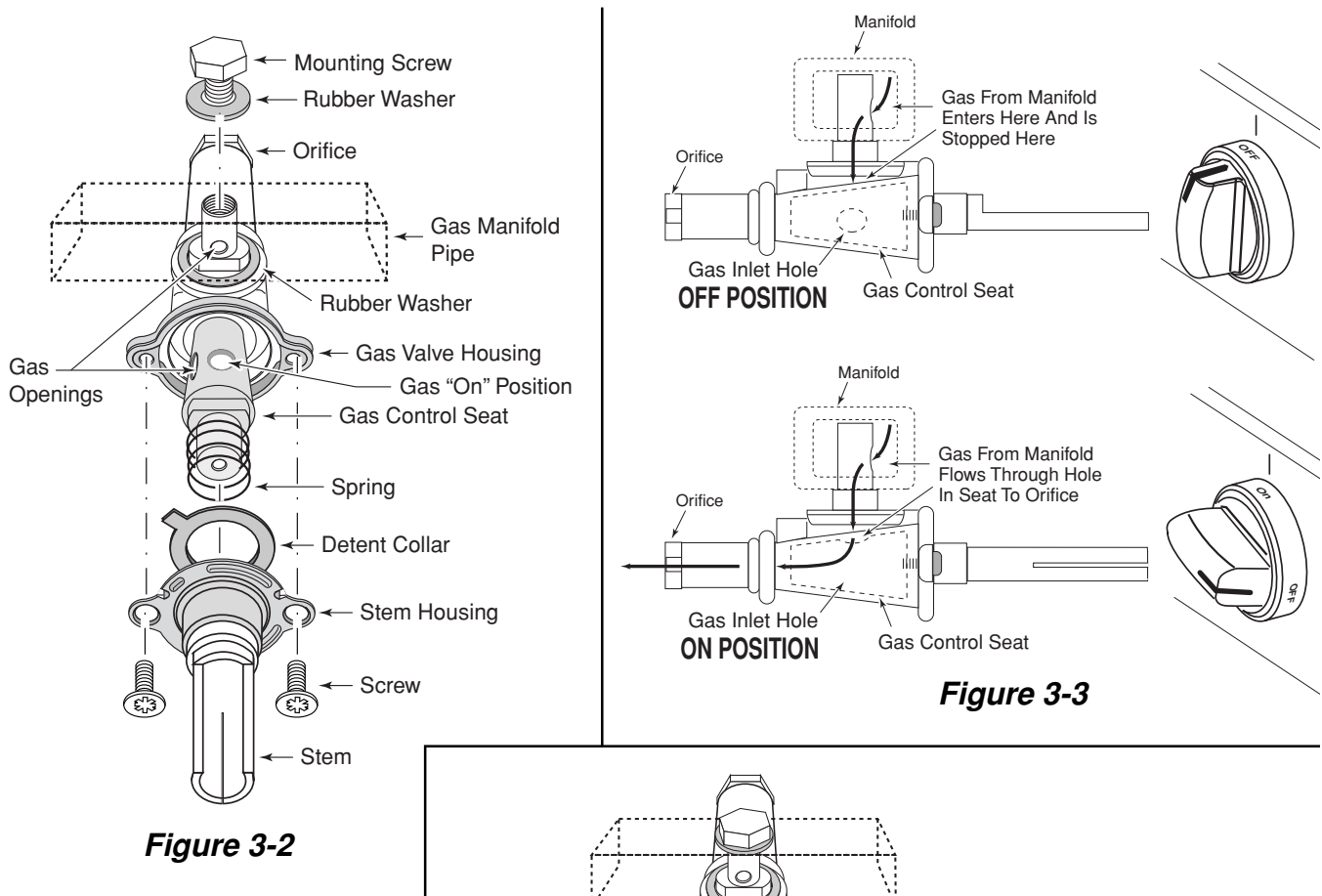


Figure 3-2

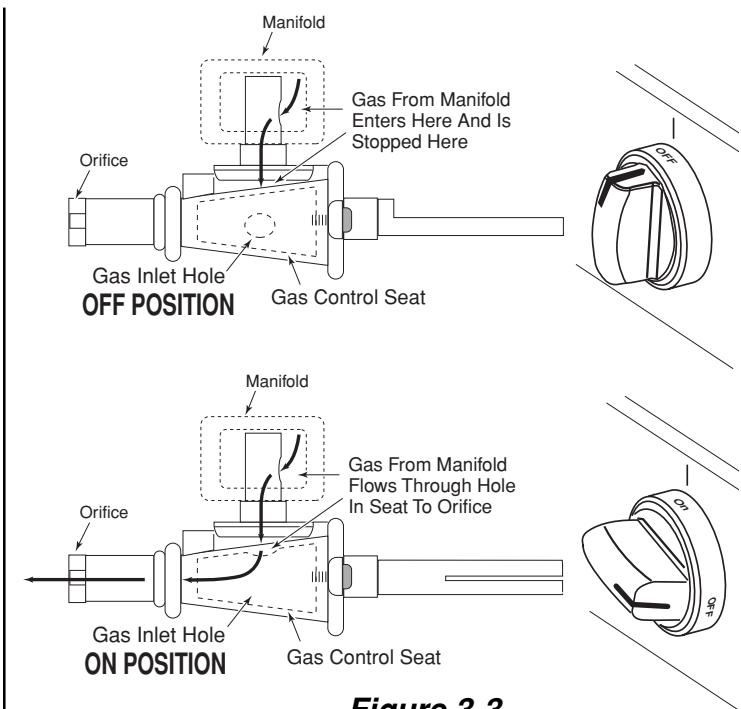


Figure 3-3

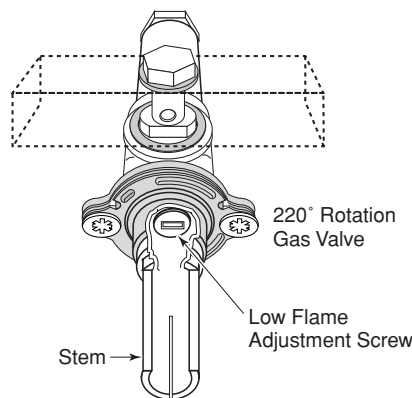


Figure 3-4

GAS VALVE ORIFICES

An orifice is an opening used to control the direction and amount of gas that is discharged to a burner. Orifices are available in different sizes and shapes and can be removed and replaced without replacing the valve.

PLUG-TYPE ORIFICES

The cooktop burner orifice uses a **plug-type** orifice, as shown in Figure 3-5. The orifice is generally constructed of brass, and consists of a threaded seat, a chamber, and a metered hole. The threaded seat allows the orifice to be securely fastened to the burner valve. The chamber is used as a passageway to allow gas to flow through the orifice opening. The orifice is used to control, or limit, the amount of gas going to the burner. This type of orifice is not adjustable.

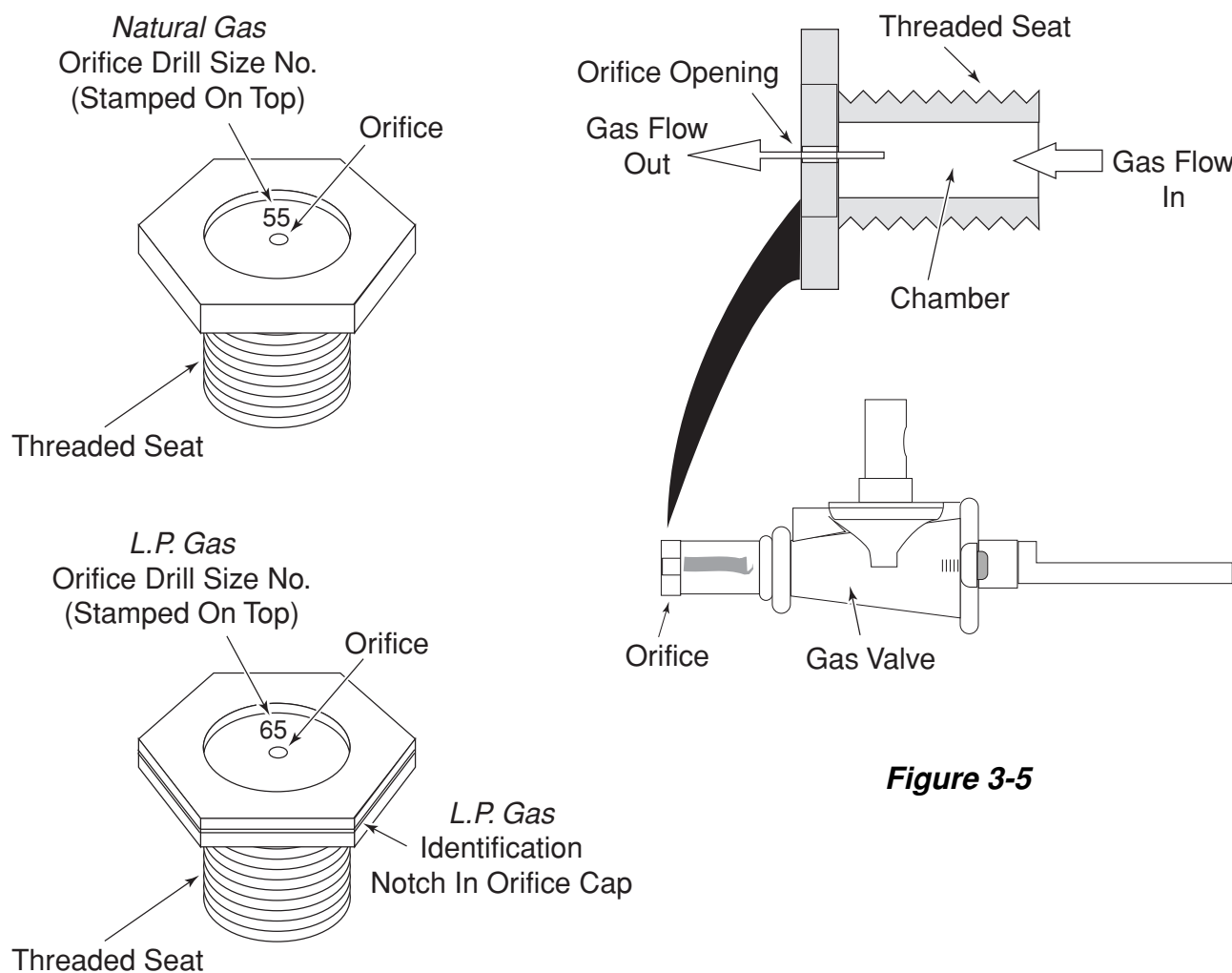


Figure 3-5

L.P. AND NATURAL GAS ORIFICES

The actual size and configuration of each orifice depends on several factors. The most important factor, however, is the type of gas that will be used by the gas range system. The two most frequently used types are: **liquefied petroleum (L.P.)** gas, and **natural** gas.

L.P. gas is generally heavier than natural gas and has a higher heat output.

For example, when one cubic foot of L.P. gas is burned, it gives off approximately 2,500 B.T.U. of heat, while one cubic foot of natural gas will yield only 1,000 B.T.U. Since the heat density of L.P. gas is higher than natural gas, it takes less cubic feet of L.P. gas to produce the same amount of heat. An L.P. orifice will always be smaller than a natural gas orifice with an equivalent B.T.U. rating (see the following "Orifice Specifications Chart"). It is also important to remember that much more air is needed with the L.P. gas system (24 cu. ft.) than with the natural gas system (10 cu. ft.). The identification color location on the valve is shown in Figure 3-6.

Orifice Specifications Chart

SUGGESTED DRILL SIZE	IDENT. COLOR	STAMPING	BTU RATING
1.45 MM	BRASS	NAT	9,500
#65	BRASS	L.P.	8,500
#55	BLACK	NAT	7,500
#68	BLACK	L.P.	6,500
1.2 MM	NICKEL	NAT	6,500
.7 MM	NICKEL	L.P.	5,500
#54	BRASS	NAT	9,000
#66	BRASS	L.P.	8,000
1.85 MM	—	NAT	12,500
#60	—	L.P.	11,500

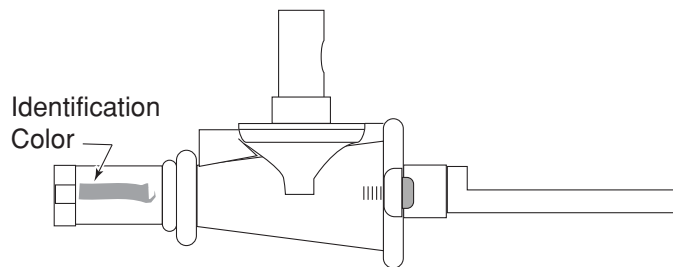


Figure 3-6

UNIVERSAL ORIFICE—OVEN APPLICATION

Gas cooking systems for both L.P. gas and natural gas can be used without changing orifices by using a **universal** orifice.

The universal orifice consists of an L.P. gas insert that is threaded into a cap orifice. This insert is actually an orifice itself. When natural gas is used, the cap is in the position shown in Figure 3-7. Gas enters through both the cap and the insert. The amount of gas leaving the orifice is controlled by the size of the cap orifice.

Natural Gas Position

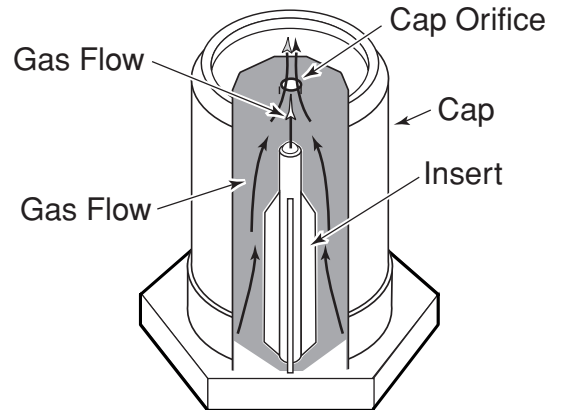


Figure 3-7

When L.P. gas is used, the cap is tightened down 2-1/2 turns so that it rests against the L.P. insert, closing off the spacing between the two (see Figure 3-8). The amount of gas leaving the orifice is now controlled by the size of the L.P. insert.

L.P. Position

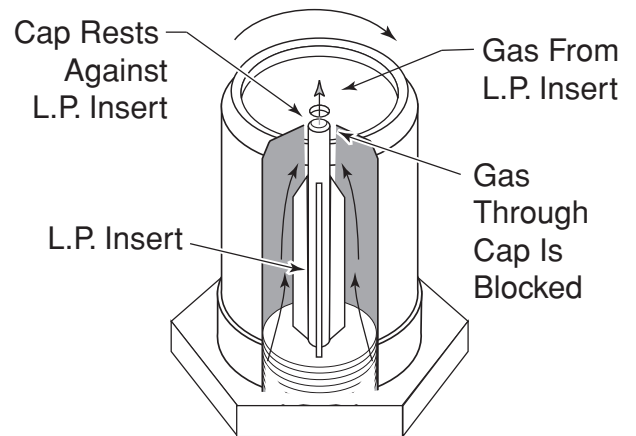


Figure 3-8

GAS VALVE ORIFICE DIAGNOSTICS

A gas valve orifice is often a source for gas range problems. Some of the problems that arise with an orifice are as follows:

1. The orifice may become clogged from dirt, or slag in the gas lines. The result will be an over-restricted gas flow, causing the mixture to become too "lean". This means that not enough gas will be mixed with air in the burner for efficient burning to occur.
2. The orifice may become cross-threaded when it is installed and allow one of three conditions to occur:
 - a) The orifice may not be aligned correctly with the venturi tube so that the gas flows straight into the burner, causing inefficient burning.
 - b) The orifice may not be secured because of the cross-threading, causing a small gas leak. The mixture will again be too lean, and inefficient burning will occur.
 - c) The orifice size may be incorrect. If a conversion is made from natural to L.P. gas, the orifice must be changed to maintain the desired heat output. The orifice size may also be too small due to a high consumption rate, so that the burner cannot meet its maximum B.T.U. output.

If it becomes necessary to clean an orifice, there are three methods that can be used:

1. Blowing forced air into the chamber.
2. Using a mild solvent and soaking the orifice for 15 to 30 minutes (the orifice can then be blown out and reinstalled).
3. Using a drill bit to clean the orifice. The bit is inserted into the orifice, then, using a slow in and out motion, the debris can be removed. A chart on page 3-4 shows the proper drill bit size to use for a particular orifice.

PERFORMANCE CHECK

1. Remove the gas valves.
2. Remove the orifices.

BURNER OPERATION

To understand how a burner operates, it is important to understand the following terms (see Figure 3-9):

- Gas:** The fuel used by the burner, either natural or L.P.
- Primary Air:** The air mixed with the gas in order to make the gas combustible.
- Secondary Air:** The supplemental, or ambient air, surrounding the flame.
- Air/Gas Ratio:** Comparison of amounts of fuel gas and air to act as primary and secondary air.

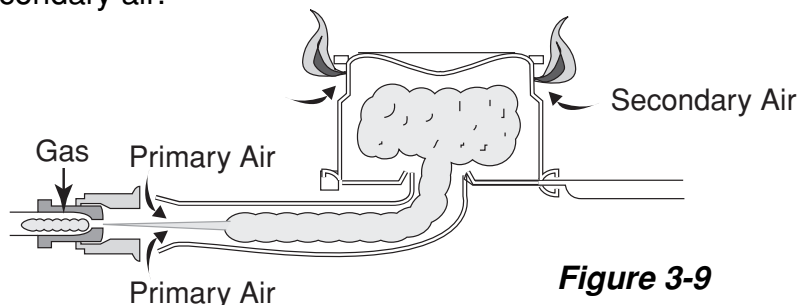


Figure 3-9

For proper operation, a burner needs the correct amount of gas mixed with the correct amount of air, referred to as the "air/gas ratio." A correct air/gas ratio will result in a flame that is stable without yellow tips. The ratio depends upon the fuel gas type being used. Ten cubic feet of air are needed to completely burn one cubic foot of natural gas (10 to 1 ratio) and twenty-four cubic feet of air are needed to completely burn one cubic foot of L.P. gas (24 to 1 ratio). (See Figure 3-10).

When broken down, 70% to 80% of the total air required is mixed with the gas as primary air. The remaining 20% to 30% is pulled into the flame as secondary air.

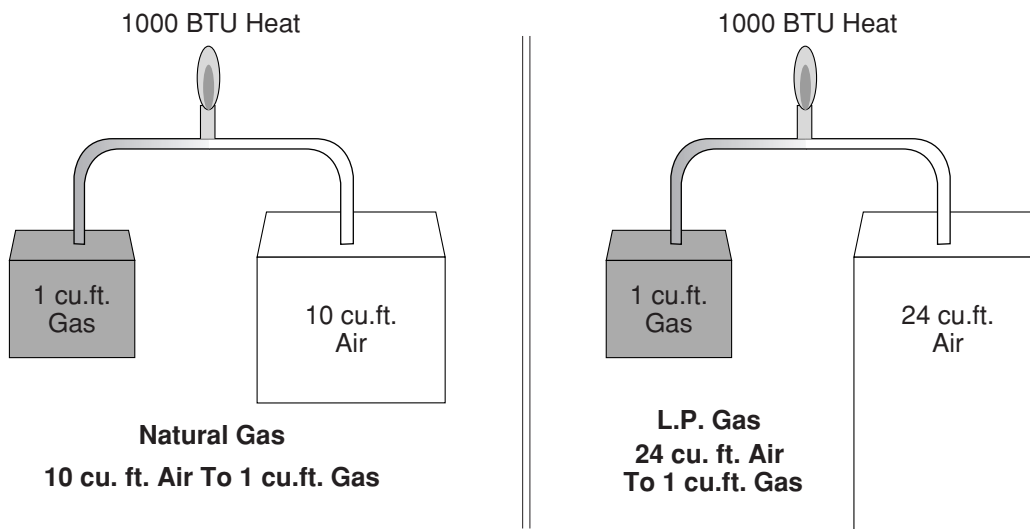


Figure 3-10

The **Cooktop Burner Assembly** controls the combustion of gas and directs its flame (see Figure 3-11). Burners are manufactured from galvanized steel and have common component parts:

1. An **Air Shutter** to control the amount of primary air to be mixed with the gas.
2. A **Venturi** to provide a pathway for gas to flow to the burner from the orifice. Air enters the burner through the venturi tube, and is used as a pathway for gas, as well as an area for gas and air to be mixed together for combustion.
3. A **Burner Head** to provide an exit for gas so it can be ignited. The exits are normally holes, or slots, called “burner ports.”

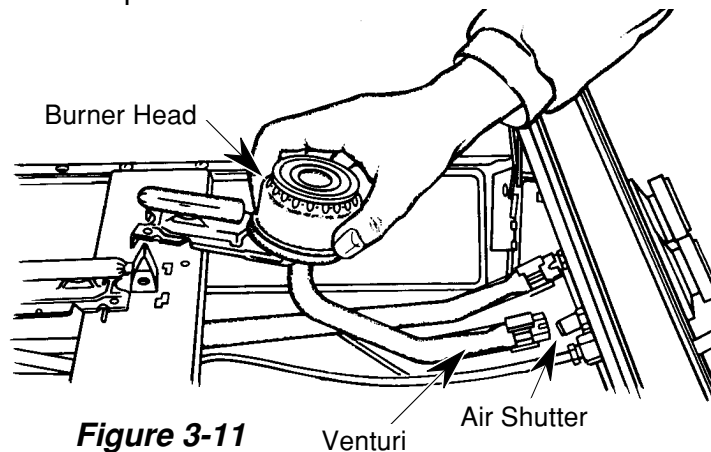


Figure 3-11

AIR SHUTTER & VENTURI

An inlet for primary air is provided before the gas supply reaches the burner port. This inlet is called an “air shutter” (see Figure 3-12). The air shutter is adjustable to allow a better adjustment of the air-gas mixture needed for combustion, and results in more efficient combustion.

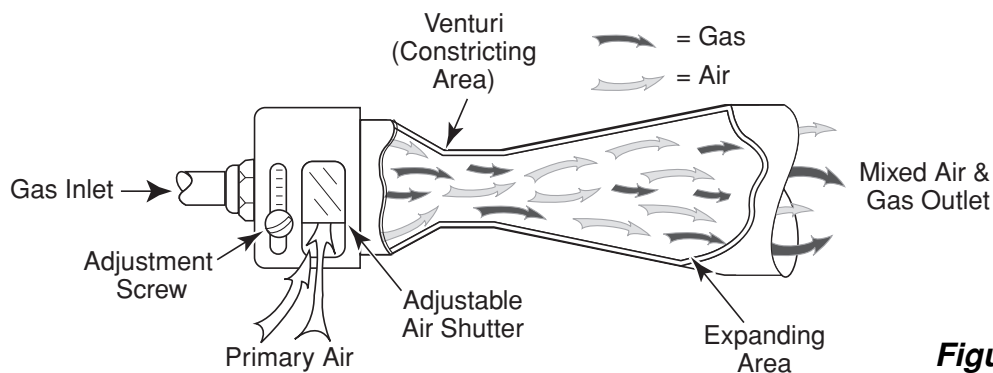


Figure 3-12

BURNER HEAD

When gas leaves the orifice, it passes through the venturi, and is forced into the burner head. As the gas passes between the orifice and the burner head, primary air is mixed with the gas to form a combustible mixture. The burner head disperses the gas/air mixture for ignition.

In addition to the burner ports at the top of the burner head, there are also ports along the side of the burner, called **charge ports** and **climber ports**. The charge ports inject gas down the flash tube to be ignited by the pilot flame. The climber ports allow the flame to climb the side of the burner head and ignite the gas at the top ports.

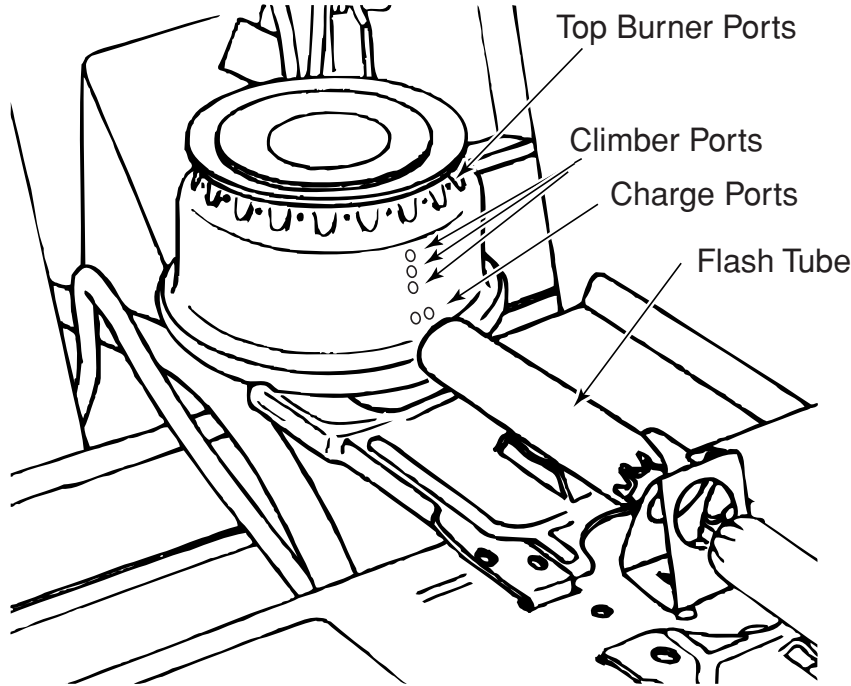


Figure 3-13

FLAME CHARACTERISTICS

A Properly Burning Flame

A properly burning flame has an inner cone, an outer cone, and an outer envelope. These three parts should be definable and distinguishable, although the outer envelope may not be easy to see. (see Figure 3-14).

The inner cone is the point where the air/gas mixture ignites and the combustion process begins. High levels of Carbon Monoxide and Aldehydes are produced in this cone.

Proper Flame Characteristics:

- Blue Color
- Flame Seated On Burner Port
- Well Defined Shape

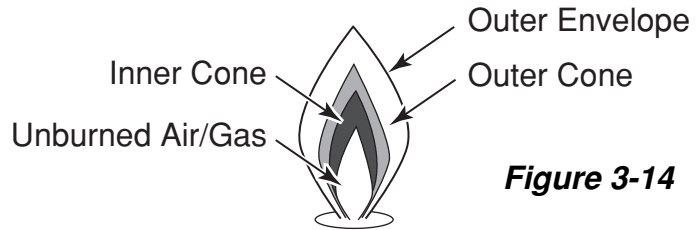


Figure 3-14

The outer cone surrounds the inner cone. The outer cone is the hottest part of the flame. Secondary air is drawn into the flame at this point and accelerates combustion. As the by-products from the inner cone move into the outer cone, they are burned and transformed into harmless water vapor (H_2O) and Carbon Dioxide (CO_2). If there is not enough secondary air, or if it is poorly ventilated and stagnant, this process cannot occur completely, and some of the harmful by-products from the inner cone will skip into the outer envelope.

The outer envelope surrounds the outer cone. The combustion process has been completed by the time the chemicals reach this point. The glow of the envelope is the result of the hot Carbon Dioxide and Water Vapor exiting the outer cone.

Too Much Primary Air

As the primary air is increased, the gas/air mixture burns at a faster speed (like fanning a flame). The additional primary air results in a greater volume of air/gas flow through the burner ports.

With increased delivery pressure and a faster burning flame, the result is a flame that blows straight out of the burner and burns with a sound similar to a blow torch. The flames lift off the burners and the cone structure of the flame is disrupted. (see Figure 3-15).

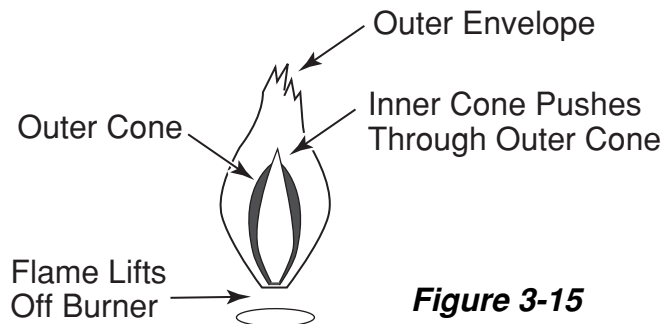


Figure 3-15

The inner-cone combustion process will occur in increased levels, and will release more of the harmful by-products, CO and Aldehydes. The level of secondary air will no longer be enough to convert these chemicals into the safe by-products CO² and H₂O, and there will be higher levels of dangerous chemicals released into the room.

NOTE: It is normal for the burners without mixing tubes to have blowing flames during the first minute of operation. When the burner is cold, primary air injection is increased. Once the burner heats, the injection of primary air is reduced and the flames settle.

Not Enough Primary Air

The reduction of primary air slows the burning process and results in the inner cone rising higher in the flame. Less burning takes place in the inner cone. A larger amount of the by-products that would be consumed in the inner cone pass into the outer cone.

The size of the outer cone is also reduced by the lack of primary air. The outer cone cannot consume the volume of by-products flowing from the inner cone. A percentage of these by-products flow into the outer envelope where the carbon content of the by-product is burned, causing the flame to have yellow tips (see Figure 3-16).

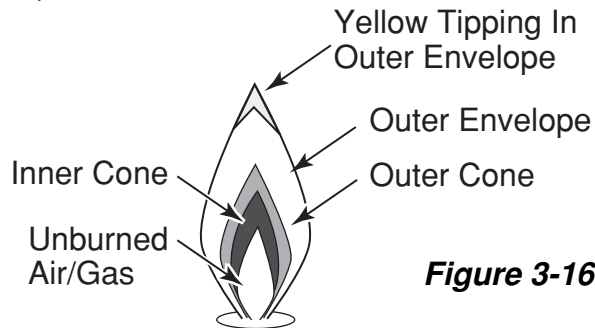


Figure 3-16

Over-Fueled Burner

Over-fueling of the burner can be caused by one of three common causes:

- Excessive gas pressure entering the burner
- The BTU rating of the gas can be too high for the burner
- An oversized gas metering orifice

It is difficult to recognize the difference between an over-fueled burner and too much primary air. In both cases, the burner flame length extends too far off of the burner (see Figure 3-17).

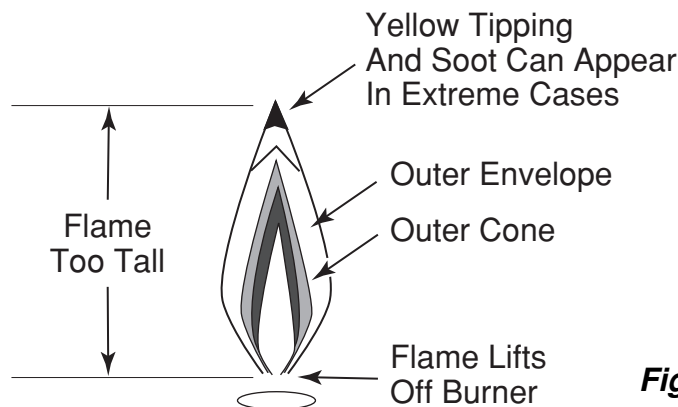


Figure 3-17

The over-fueled burner has more of a normal flame structure and less of a blowing noise than a burner with too much primary air. The easiest way to determine whether the burner is over-fueled is to vary the air shutter opening size. If the flame length can be reduced to the correct size and structure by adjusting the air shutter, then the problem is not an over-fueled burner.

Top burners should have a cone length of approximately 5/8" (see Figure 3-18).

For L.P. installations and models without adjustable orifices, the orifice must be replaced with a recommended L.P. sized orifice.

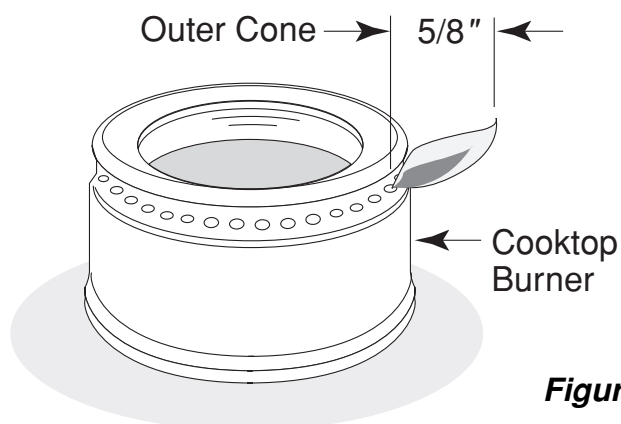


Figure 3-18

Flame Quenching

Flame quenching occurs when the flame is cooled before complete combustion occurs. Placing an object, such as an oven flame spreader into the flame, will cool or quench the flame, resulting in incomplete combustion. The object interrupts the combustion process and releases the unburned by-products from the inner or outer cone of the flame.

The height of the surface burners in relation to the burner grates should always be closely examined and measured. If the burner is too close to the grate or too close to the maintop, quenching can result and possibly cause damage to the maintop.

Top burners can be bent out of adjustment easily by putting excessive weight on them, for example, by leaning on them. The distance from the highest point of the burner to the top of the grate should be approximately 3/4" (see Figure 3-19).

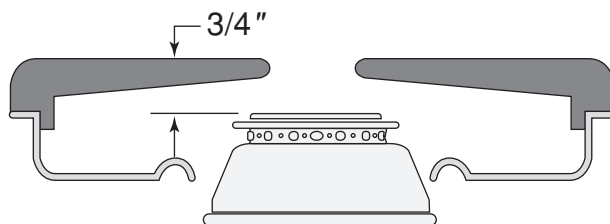


Figure 3-19

In the case of an over-fueled burner, the excessive length of the flames can result in the quenching at the oven flame spreader or top burner grate even though the flame spreader and grate may be at the proper distance. Check for this before adjusting the burners.

When quenching occurs, (see Figure 3-20), the customer may complain of a chemical odor. This odor results from the Aldehydes being released from the flame as one of the by-products of incomplete combustion. Some customers may associate this odor with a gas smell, but the two odors are quite different. By examining the flame length between the burners and other components, and by looking for an out of place component, the cause of the quenching can easily be located.

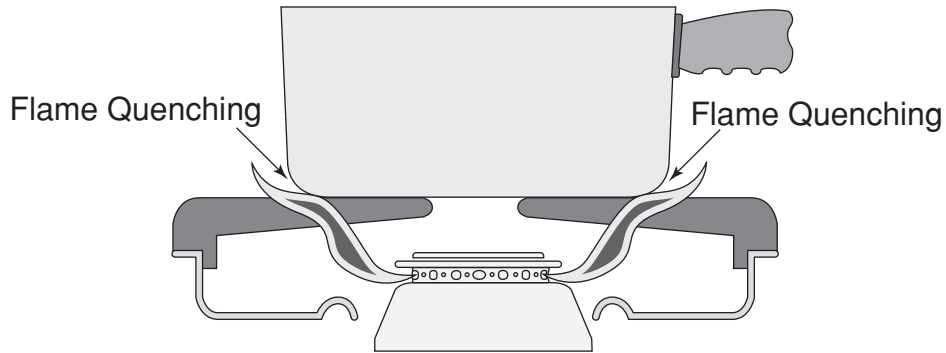


Figure 3-20

IMPROPER FLAME DIAGNOSTICS

For any of the improper flames discussed, refer to the following chart for the appropriate corrective actions. In most of the malfunctions described thus far, the burner flames will change characteristics when a problem develops. However, there are times when the symptom of a burner problem is an unusual noise. The noise may be a “rumbling” or “gurgling” sound or a “high pitched squeal” or “burr.” In any event, the table lists burner noise malfunctions and their respective causes and corrective actions.

Symptom	Cause	Corrective Action
Flame is white-blue and has hard, sharp features.	Excessive primary air.	Adjust air shutter.
Flame is small and blue in color.	<ol style="list-style-type: none"> 1. Clogged burner orifice. 2. Clogged venturi. 3. Restricted or clogged gas line. 4. Excessive low gas pressure. 	<ol style="list-style-type: none"> 1. Clean or replace burner orifice. 2. Clean venturi. Replace burner, if necessary. 3. Remove & clean the gas supply line. Relace, if necessary. 4. Use a manometer and adjust the gas pressure.
Flame is yellow.	<ol style="list-style-type: none"> 1. Insufficient primary air. 2. Blocked primary air shutter. 3. Oversized burner orifice. 	<ol style="list-style-type: none"> 1. Adjust primary air shutter. 2. Clean primary air shutter & adjust for proper air-gas mixture. 3. Replace burner orifice.
Flame is noisy (rumbles or gurgles).	<ol style="list-style-type: none"> 1. Excessive primary air. 2. Excessive gas pressure. 	<ol style="list-style-type: none"> 1. Clean primary air shutter & adjust for proper air-gas mixture. 2. Use a manometer and adjust the gas pressure.
Orifice noise (burr or high-pitched squeal).	<ol style="list-style-type: none"> 1. Debris lodged in orifice. 2. Improper orifice size. 3. Excessive gas pressure. 	<ol style="list-style-type: none"> 1. Clean orifice. Replace, if necessary. 2. Replace orifice. 3. Use a manometer and adjust the gas pressure.
Air intake or mixing noise.	<ol style="list-style-type: none"> 1. Rough area in mixing tube or venturi. 2. Loose debris in mixing tube or venturi. 3. Burner not seated correctly over orifice. Distance between orifice and venturi too large. 	<ol style="list-style-type: none"> 1. Smooth interior surface. Replace burner, if necessary. 2. Clean mixing tube. 3. Seat burner over orifice.
Erratic burner flame (fluctuates high to low).	<ol style="list-style-type: none"> 1. Gas regulator flutter. 2. Control valve malfunction. 	<ol style="list-style-type: none"> 1. Replace pressure regulator, if necessary. 2. Adjust regulator on control valve. Replace, if necessary.

CLEANING THE BURNERS

The most common burner malfunction is clogging due to excess dirt and debris, which can enter the burner through the burner ports. This excess dirt can block one or several of the ports so that the burner will have trouble lighting, or will not light at all. In this case, the burner ports must be cleared using a pin (see Figures 3-21 and 3-22).

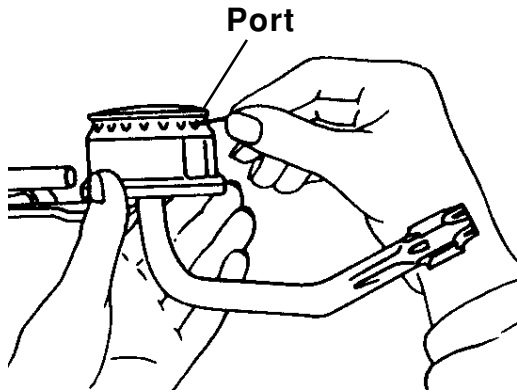


Figure 3-21

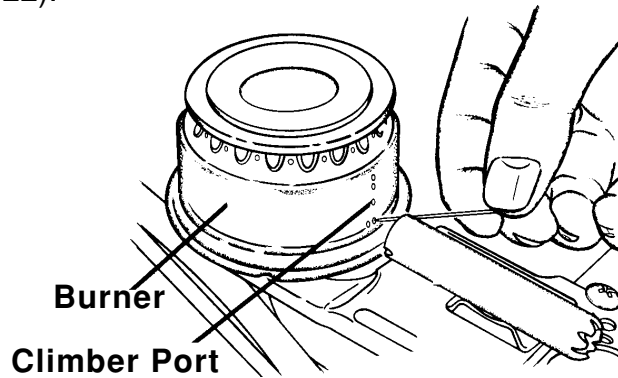


Figure 3-22

The primary air shutter is an additional inlet where dust can enter a main burner. Whether or not the burner is operating, dust can still be drawn into the burner through the air shutter. The debris can clog the venturi, orifice, or burner ports. Again, this type of clogging can reduce, if not stop, the flow of gas through the burner. In addition, the primary air shutter itself can become blocked, restricting the flow of primary air into the burner.

In any event, cleaning the burner normally eliminates most of the dirt buildup. Also, it is a good practice to keep the area immediately surrounding the main burner as clean as possible to reduce the possibility of clogging any part of the main burner.

STANDING PILOT IGNITION SYSTEM

OPERATION

The ignition system provides heat, which is the third element necessary for combustion. Whirlpool ranges use two different processes to provide this element. The first process is a standing pilot ignition, and the second is an electronic ignition.

The primary purpose of a standing pilot is to ignite the main burner. Pilot assemblies consist of a gas supply tube and an adjustment screw that controls the amount of gas flow to the pilot.

To produce a pilot flame, gas is supplied through the gas supply tube (see Figure 3-23), and directed toward the pilot opening, or port. As the gas is available it is manually lit. The pilot flame is usually set to a height of approximately 1/4". This is accomplished by turning the pilot adjustment screw until the desired flame is produced (see the inset). The flame should have a distinct blue body.

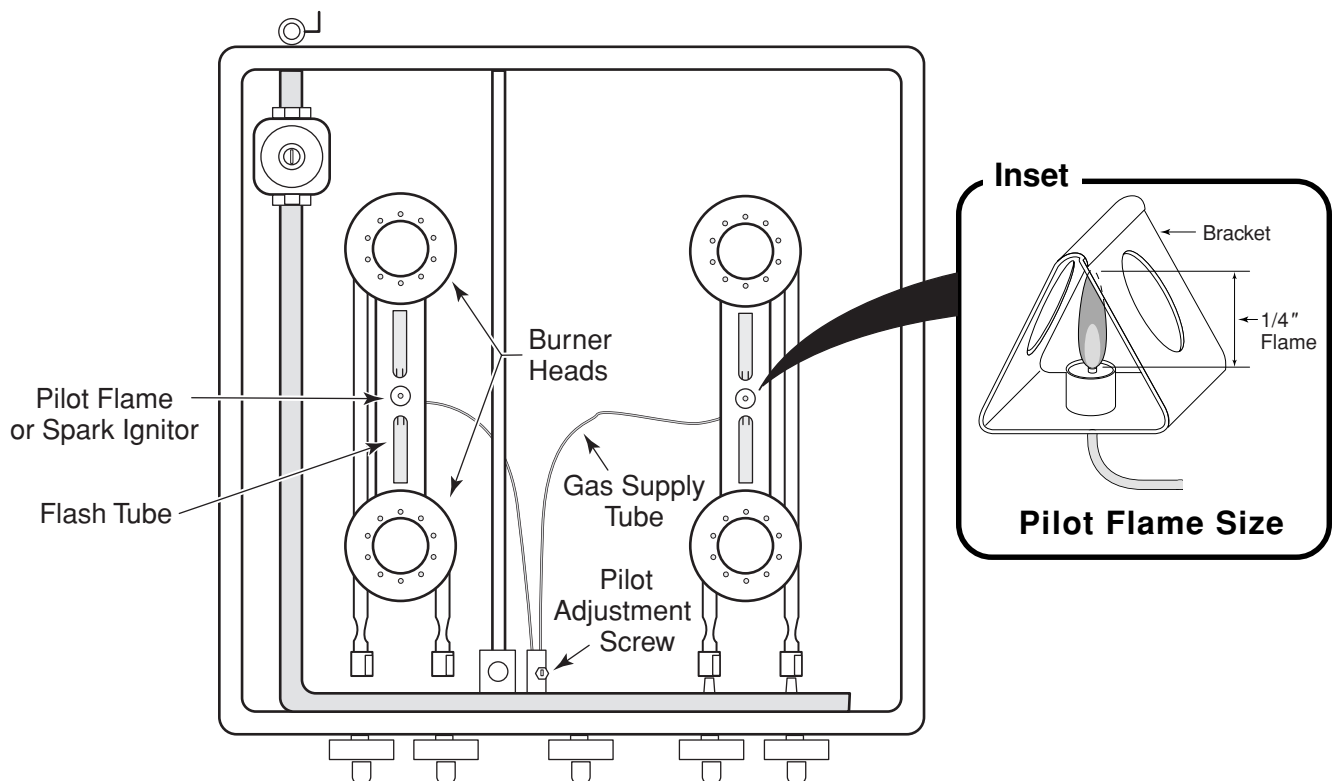


Figure 3-23

When the gas control valve is turned on, gas flows to the burner head, and out the ports. There are ports at both the top and side of the burner head, as shown in Figure 3-25. The side ports direct gas to a **flash tube**, where it is drawn through the tube to the pilot flame, where it is ignited inside the tube. The ignited gas is then flashed back to the main burner, where gas from the top ports is ignited by the pilot flame. The burning gas from the pilot also helps to draw gas through the tube for combustion.

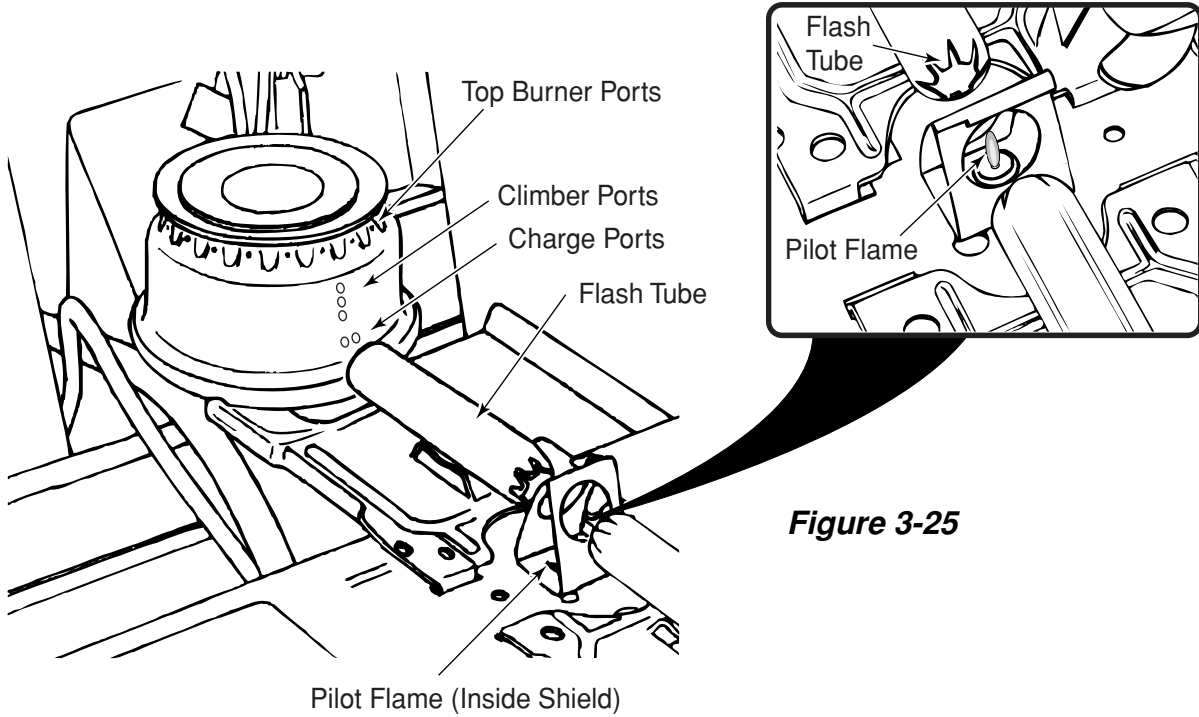


Figure 3-25

RELIGHTING A STANDING PILOT

Caution: If the pilot has been out for some time and you detect a strong odor of gas, ventilate the room before trying to relight the pilot.

Turn off all range controls and prop open the cooktop. Place a lighted match near the opening of the pilot, located midway between two burners, as shown in Figure 3-26. If the pilot does not stay lit, clean, or adjust it.

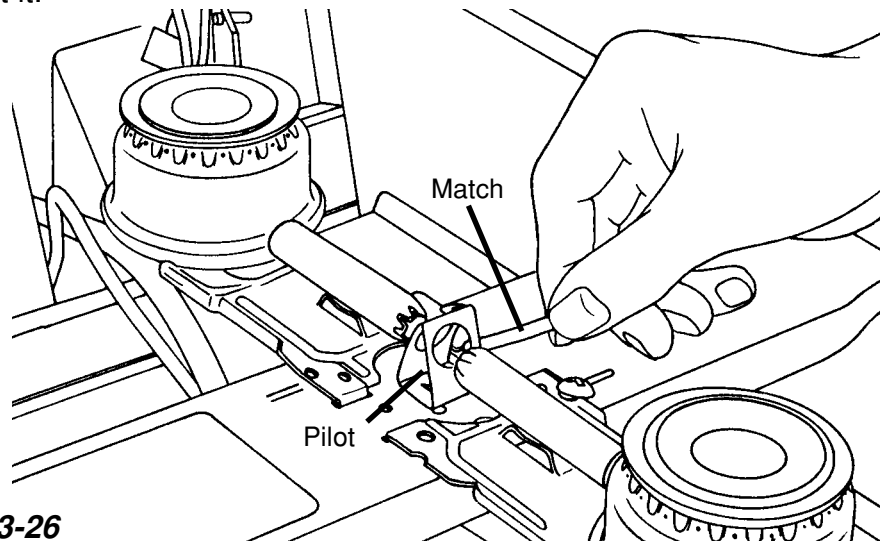


Figure 3-26

ADJUSTING THE PILOT FLAME HEIGHT

A pilot that frequently blows out may be set too high, or too low. To adjust the pilot flame to the correct height, perform the following steps:

1. Turn off the controls and prop open the cooktop.
2. Using a screwdriver, turn the needle valve screw slowly in the direction necessary to set the size of the pilot flame, as shown in Figure 3-27. The flame should have a sharp, blue cone that is approximately 1/4" high, as shown in the inset.
3. Lower the cooktop.

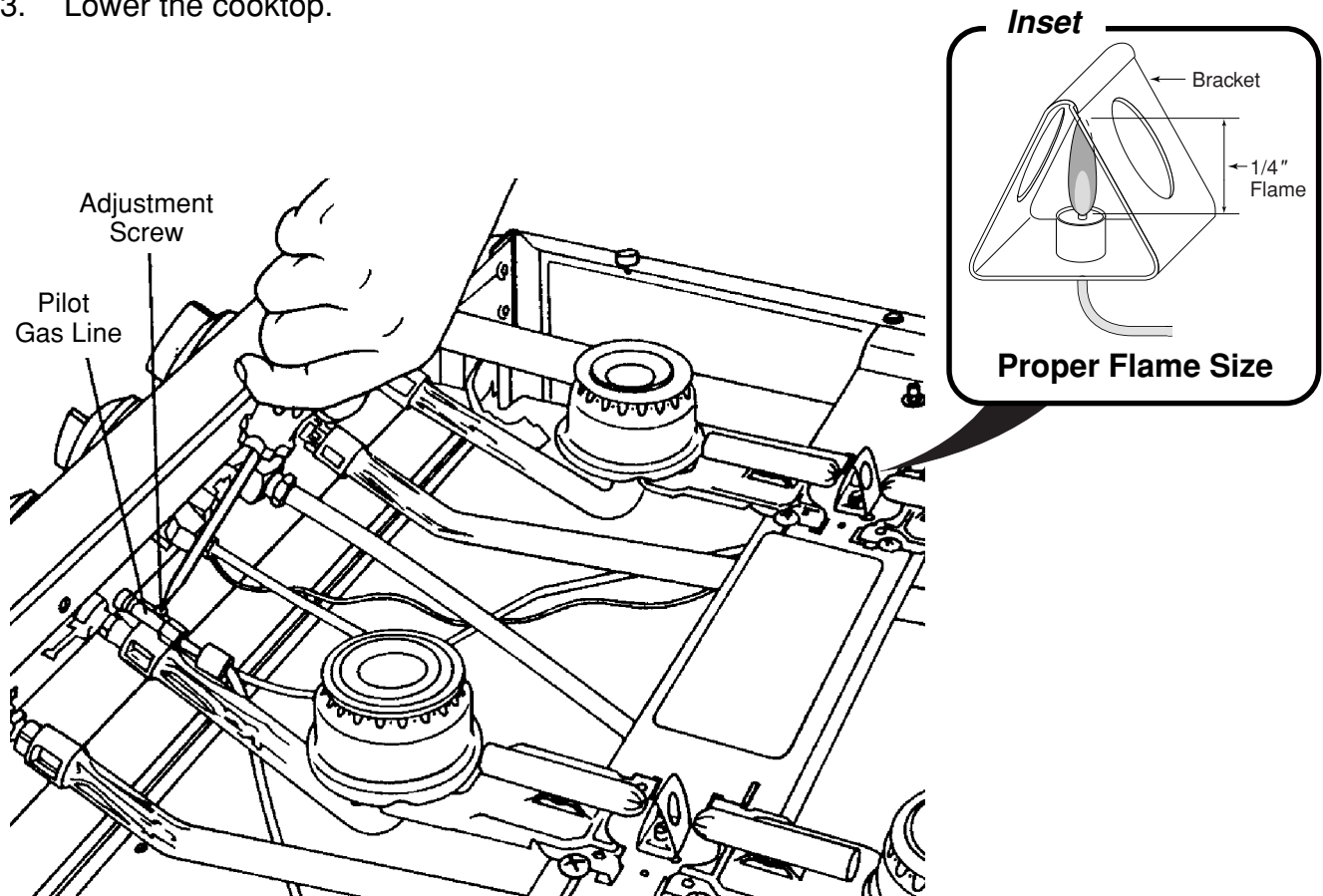


Figure 3-27

CLEANING THE PILOT

The small opening of a pilot can easily become clogged with dust, grease, or food, preventing proper gas flow. A pilot that will not light, or will not stay lit, may simply need to be cleaned.

To clean the pilot, insert a straight pin into the pilot opening, as shown in Figure 3-28, and move it up and down gently, being careful not to enlarge or deform the opening. If there is a protective metal shield over the pilot that prevents you from reaching the opening, remove it by pressing in on the tabs on either side, and unhooking it.

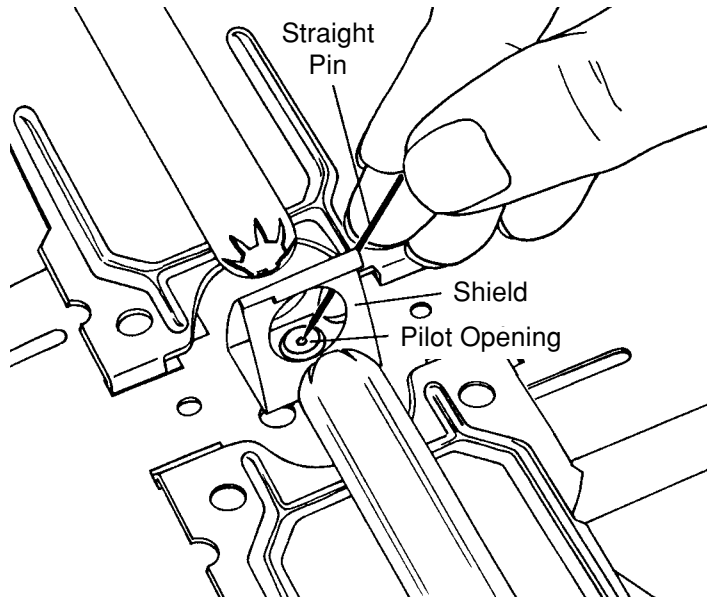


Figure 3-28

ELECTRONIC IGNITION SYSTEM

OPERATION

The **Electronic Ignition System** performs the same function as the standing pilot ignition system. However, instead of using a standing pilot flame to ignite the main burners, a spark from a surface burner ignitor is used.

The electronic ignition system consists of the following components:

1. Ignitor Switches
2. Ignitor Spark Module
3. Surface Burner Ignitors (electrodes)

Ignitor Switches control the voltage to the ignitor spark module by opening and closing the circuit. The ignitor switches are mounted on the stem of each burner control valve, and are rotary-actuated. There are two types of switches used on Whirlpool ranges. One is for a 90° valve, shown in Figure 3-29, and the other is for a 220° valve. Each gas valve has its own ignitor switch. The ignitor switches are wired in parallel.

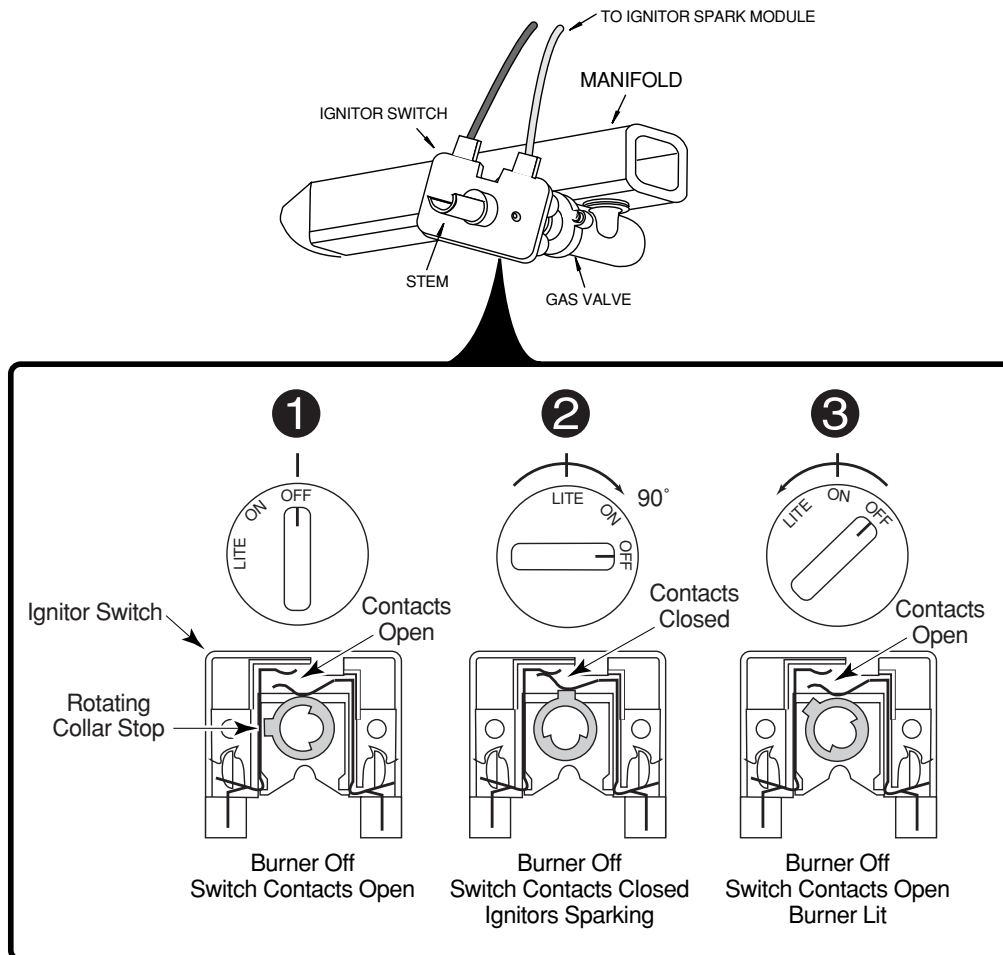


Figure 3-29

The **Ignitor Spark Module** is a solid-state device that is used to provide high voltage for the top burner ignitors (see Figure 3-30). Whenever the ignitor module is energized by one of the ignitor switches, a solid state circuit and pulse transformer within the module electronically increases the constant AC line voltage to periodic high voltage pulses, and sends these pulses to all of the ignitor electrodes at the same time. The pulses will be sent to the ignitors at about 2 pulses (sparks) per second. There are no adjustments that can be made to the module and it is serviced only as an assembly. **The system operates at very low amperage (4 milliamps) so that the high voltage pulses, or sparks, present no severe shock hazard.**

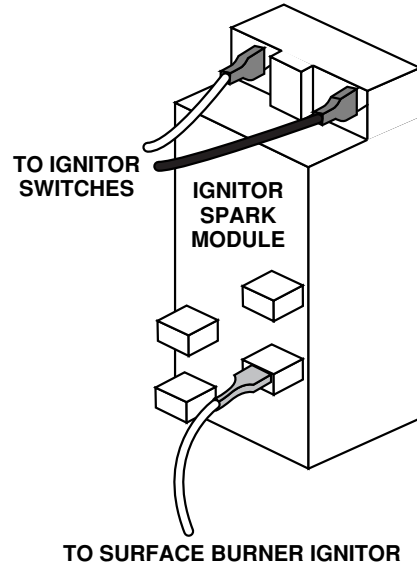


Figure 3-30

A **Surface Burner Ignitor** is a metal rod with a ceramic insulating body that is wired directly to the ignitor spark module. Pulses from the ignitor module cause the ignitor to arc to the ground strap (see Figure 3-31). These pulses, or sparks, light the top burners through the flash tube.

The surface burner ignitors are manual ignitors that spark whenever a burner valve is in the “lite” position. The module will continue to send pulses to the ignitor until the valve is turned to any position other than “lite.”

Since the system operates on high voltage pulses sparking to ground, it is very important that the range be properly grounded, and that chassis ground through the range is continuous.

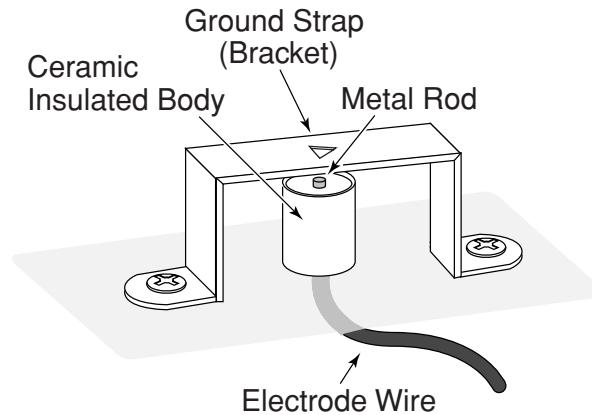


Figure 3-31

Refer to Figure 3-32 for the following sequence.

CONVENTIONAL BURNER

When a main burner control knob **1** is turned to the “lite” position, the gas valve **2** opens, and gas flows through the pressure regulator **3** into the manifold **4** through the open valve. As gas passes through the valve and its orifice, it is directed into the venturi **5**, where it mixes with primary air to create the proper mixture necessary for combustion.

At the same time, line voltage is applied through the ignitor switch **6**, to the ignitor spark module **7**, which produces high-voltage pulses to all of the spark ignitors **8**. The pulses cause a spark **9** to occur between the spark ignitor electrode, and the ground strap (bracket) **10**. The gas and air mixture at the burner head, **11** flows through the three climber ports in the side of the head, and into the flash tube **12**. As gas flows through the flash tube, it is ignited by the spark. The combusted gas flashes back through the tube, and ignites the burner.

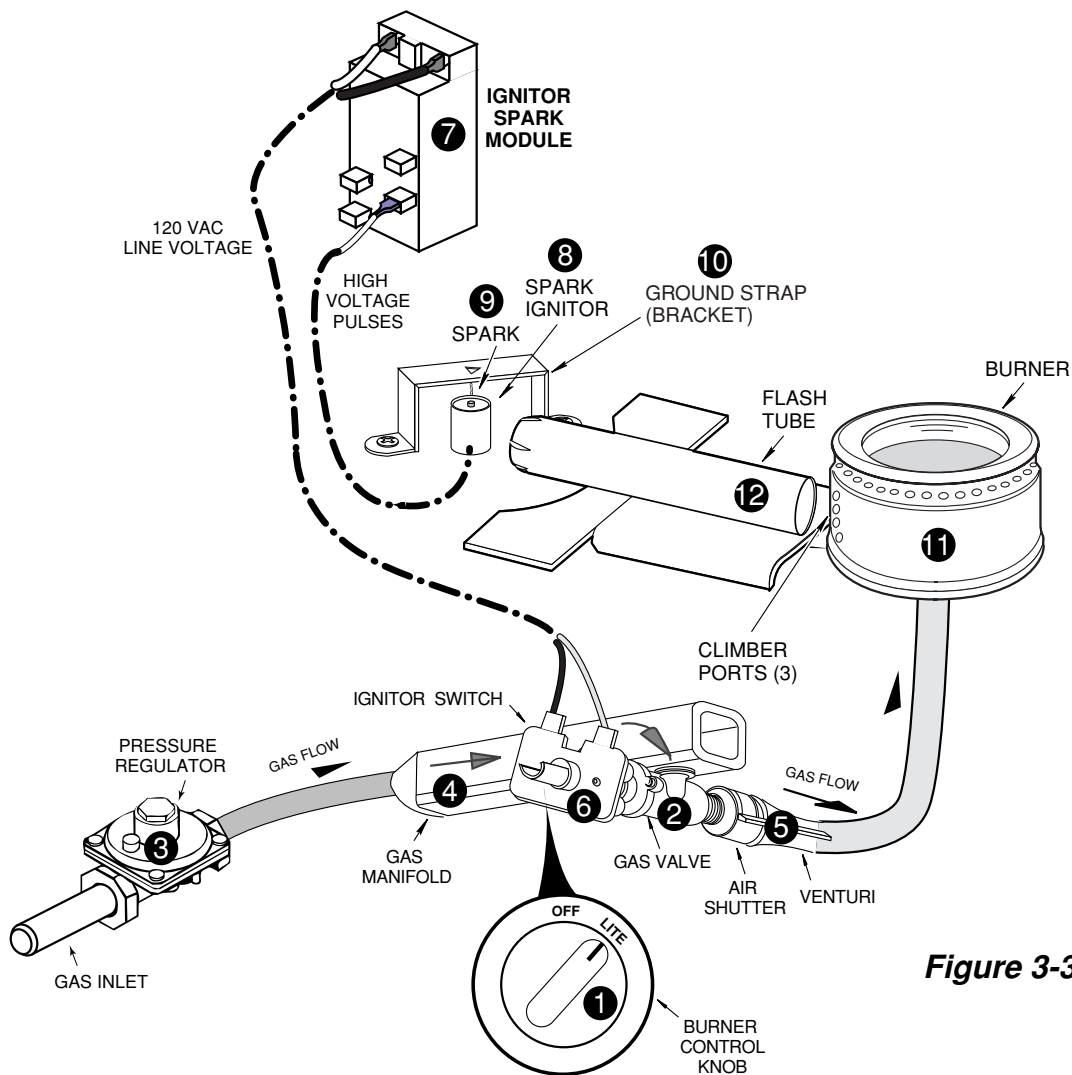


Figure 3-32

Refer to Figure 3-33 for the following sequence.

SEALED BURNER

When a main burner control knob **1** is turned to the “lite” position, the gas valve **2** opens, and gas flows through the pressure regulator **3** into the manifold **4** through the open valve. As gas passes through the valve and its orifice, it is directed into the venturi **5**, where it mixes with primary air to create the proper mixture necessary for combustion.

At the same time, line voltage is applied through the ignitor switch **6**, to the ignitor spark module **7**, which produces high-voltage pulses to all of the spark ignitors **8**. The pulses cause a spark **9** to occur between the spark ignitor electrode, and the grounded burner cap **10**. The gas and air mixture at the burner head is ignited by the spark, and a flame is produced at each of the top burner ports.

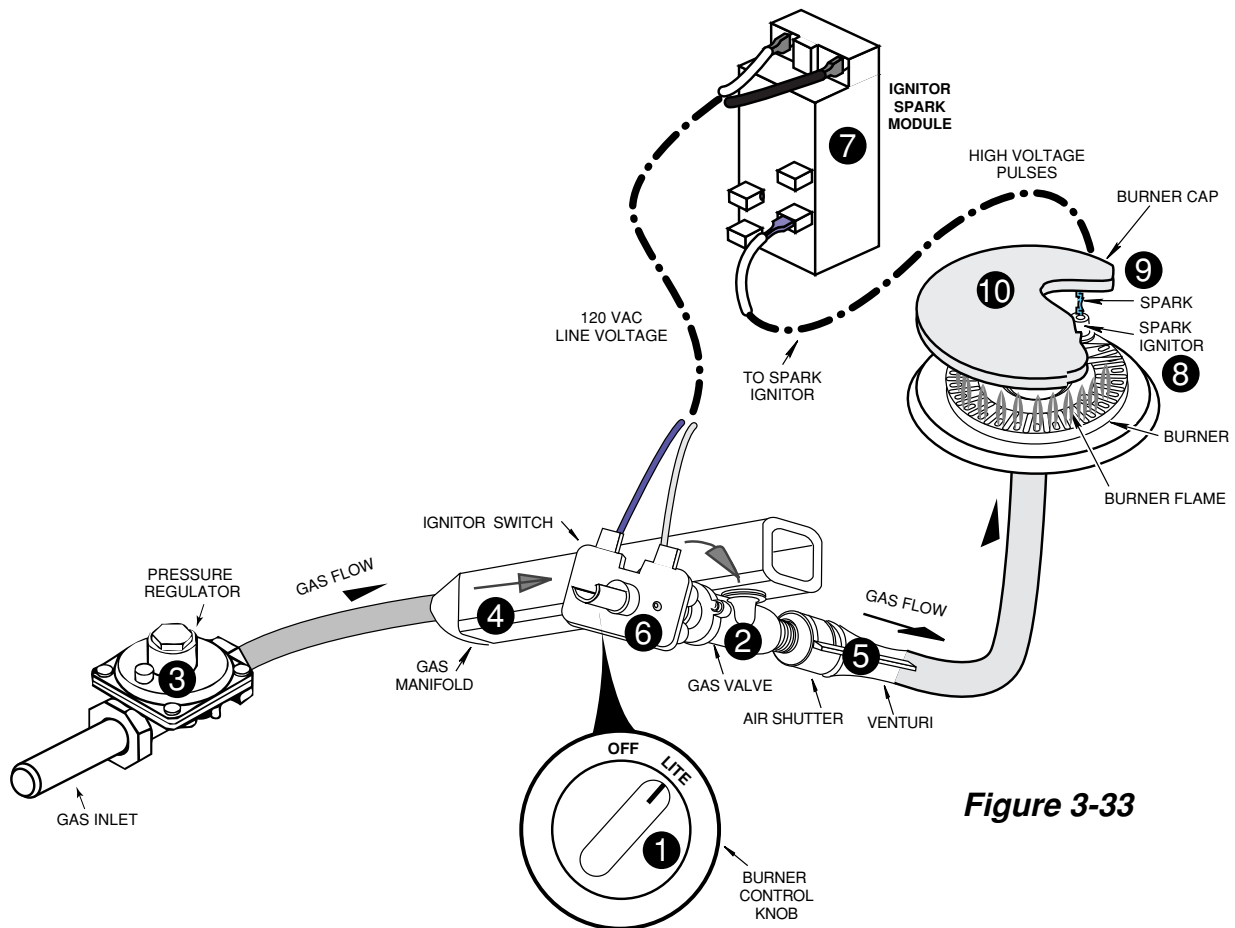


Figure 3-33

ELECTRONIC IGNITION DIAGNOSTICS

Problems with electronic ignition systems usually occur in one of two ways: the electrode will not spark, or the sparking will not stop.

If the ignitors are in series, and one is not sparking, none will spark. Also, all spark ignitors use the same ignitor spark module, but different switches. If one burner is not igniting while the gas valve is still open to that burner, turn on another burner that does not share the same ignitor. In this way you can isolate the problem to the switch, the spark ignitor, or the ignitor spark module.

To check for a bad ignitor switch, pull the leads from the switch, touch the bare lead ends together, and see if the ignitor sparks. **CAUTION: When testing these switches, do not forget that they operate on 110 volts, so do not touch the lead ends, or you will receive an electrical shock. Use a pair of insulated needle nose pliers to pull the leads off the switch.**

If the ignitors will not stop sparking, usually one of the ignitor switches has shorted. A short is usually caused by moisture getting into the switch contacts. To determine the defective switch:

1. Pull one lead off each switch, one at a time, until the sparking stops.
2. Pull the defective switch off the control valve, and replace it.

A defective ignitor spark module can also cause a “no spark” condition. If none of the ignitor switches seem to be defective, replace the ignitor spark module.

PERFORMANCE CHECK

1. Remove the burners.
2. Remove the ignition system (ignitor spark module, ignitor switches, and surface burner ignitors).

THE OVEN BURNER SYSTEM

STANDING PILOT IGNITION

The complete **Standing Pilot Ignition System** (see Figure 4-1) is controlled by two very important mechanical components. The first is a thermostat that is mounted on the manifold pipe and accessible to the customer, and the other is an oven safety valve that controls the gas flow into the oven burner. If either of these components is not working properly, the system will not function. The burner, air shutter, and venturi are also critical components, and work the same as on the cooktop burners that were discussed in Section 3.

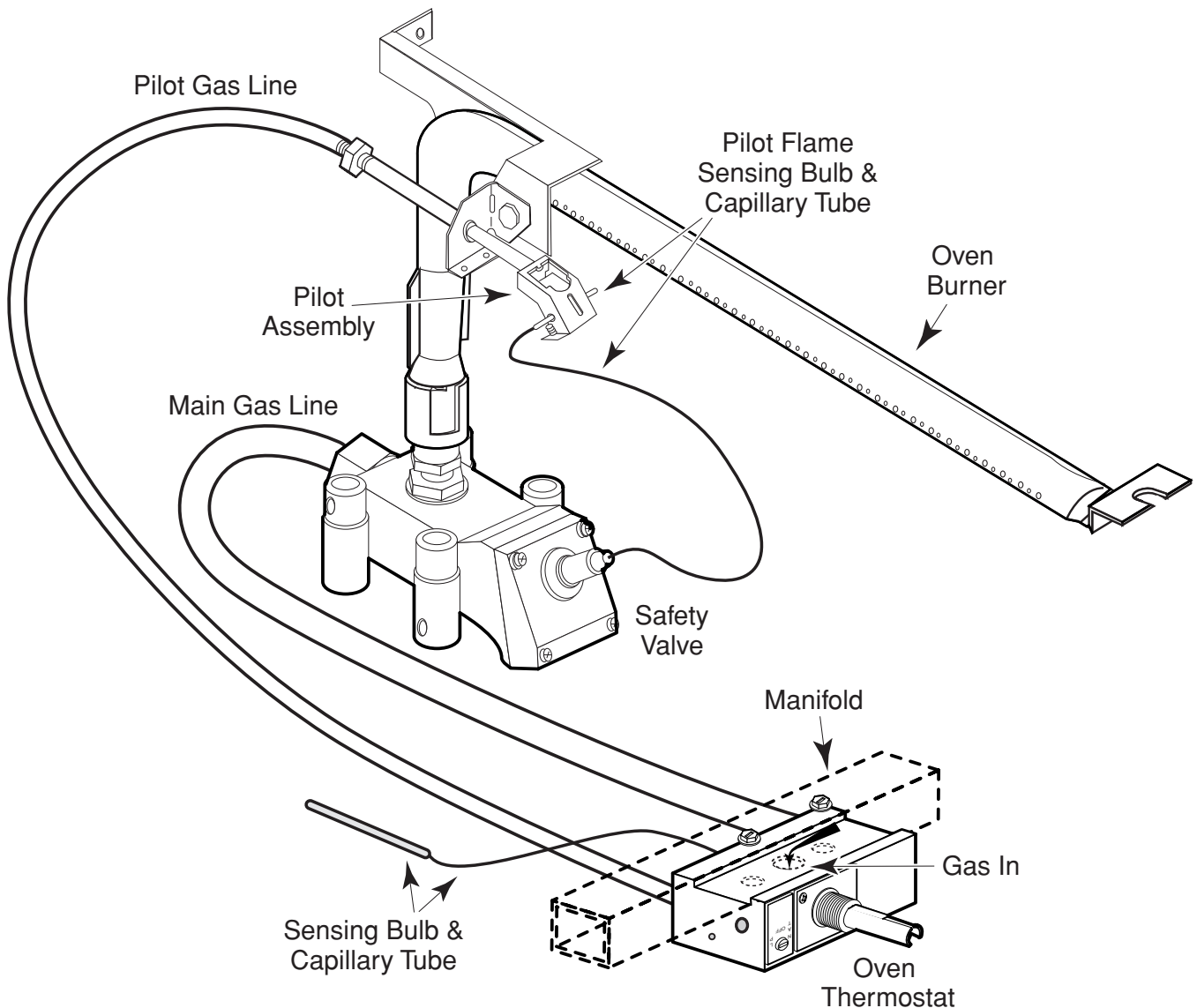


Figure 4-1

The **Thermostat** is a hydraulic valve that has two separate gas lines and a sensing bulb (see Figure 4-2). The **pilot** gas line maintains a pilot flame in the oven, and the **main** gas line provides gas to the oven safety valve. The **sensing bulb** is a mercury-filled tube that controls the thermostat to open or close the gas lines, and release gas from the manifold pipe to the oven safety valve. The thermostat operates based on the temperature it senses in the oven cavity.

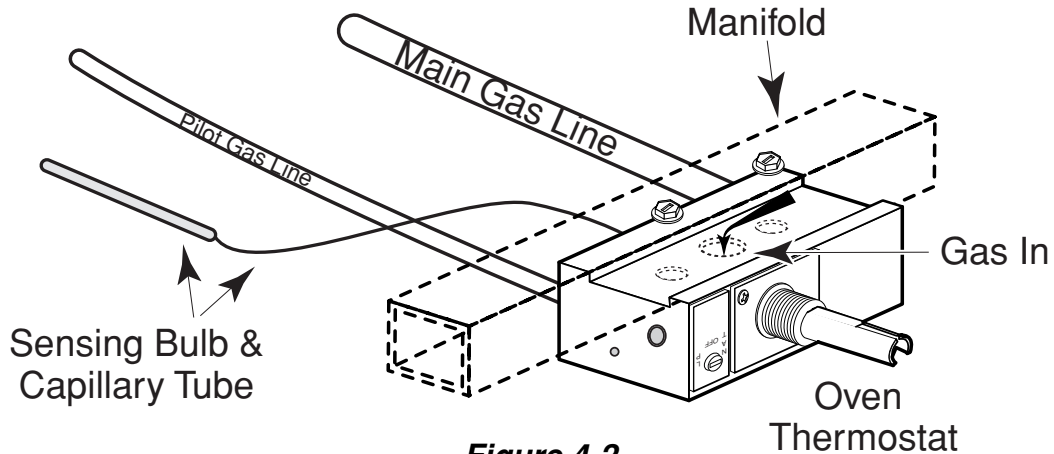


Figure 4-2

The **Oven Safety Valve** is also a hydraulic valve that has a gas inlet line and a gas port that is metered by an orifice hood (see Figure 4-3). It also has a mercury-filled sensing bulb that controls its operation. The safety valve has one function: to release gas to the oven burner from the thermostat.

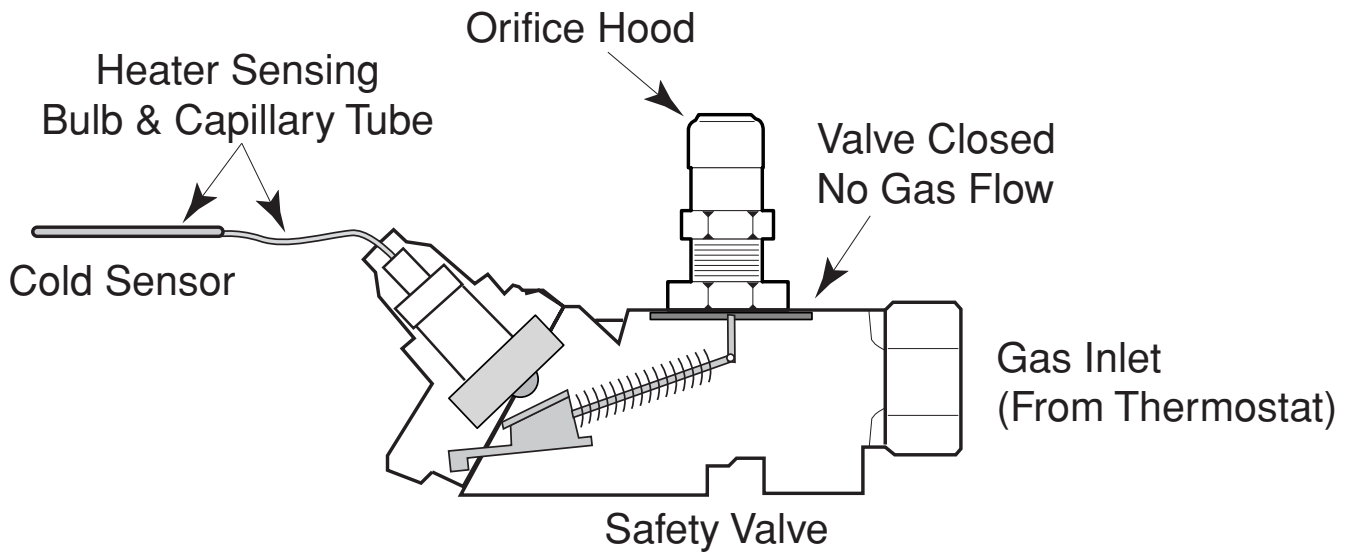
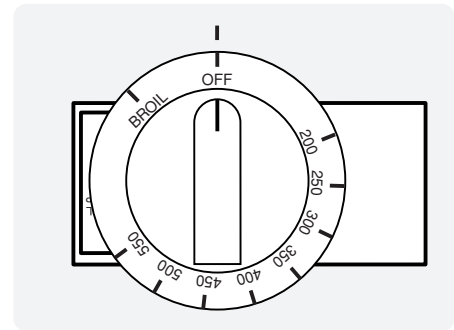
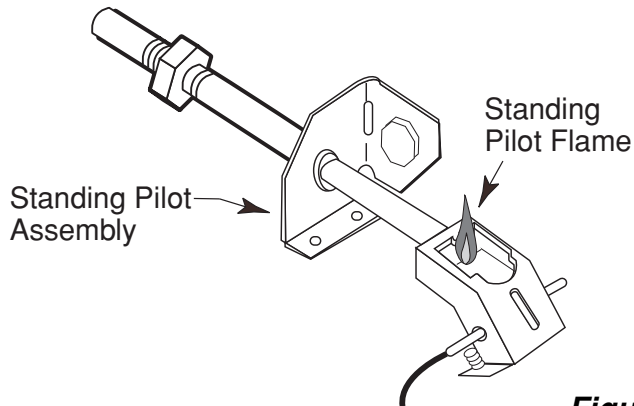


Figure 4-3

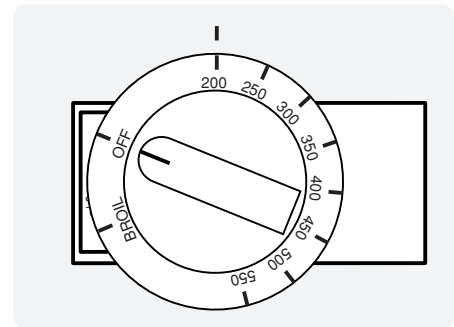
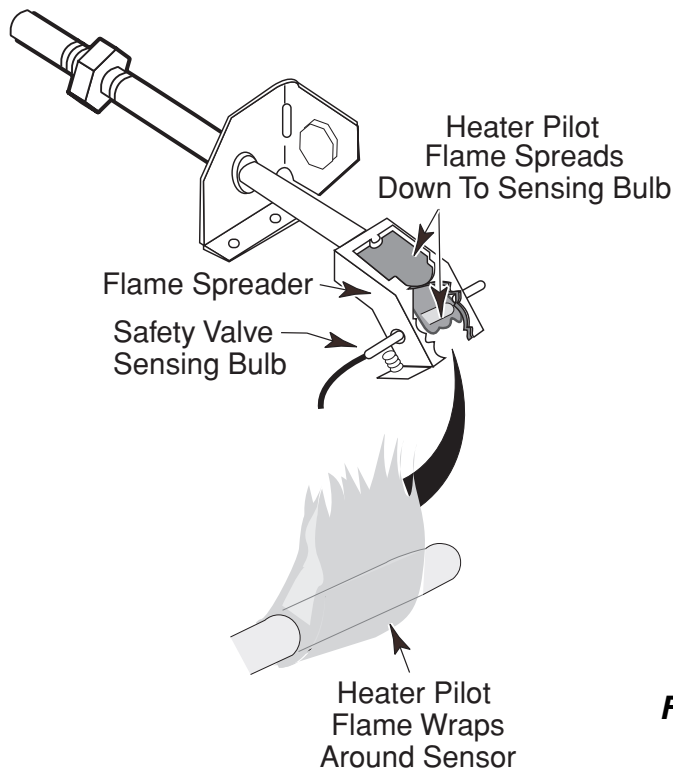
The interaction between the thermostat and the safety valve is very important and critical to the operation of the oven. The thermostat provides two separate functions each time it is turned on, but first, we need to know what the thermostat does when it is in the “OFF” position. Even with the thermostat in the “Off” position, a supply of gas from the manifold pipe is always available through the thermostat to the oven pilot assembly. It supplies enough gas to maintain a constant or “standing” pilot flame in the oven at all times (see Figure 4-4).



**The Standing Pilot
Thermostat Off**

Figure 4-4

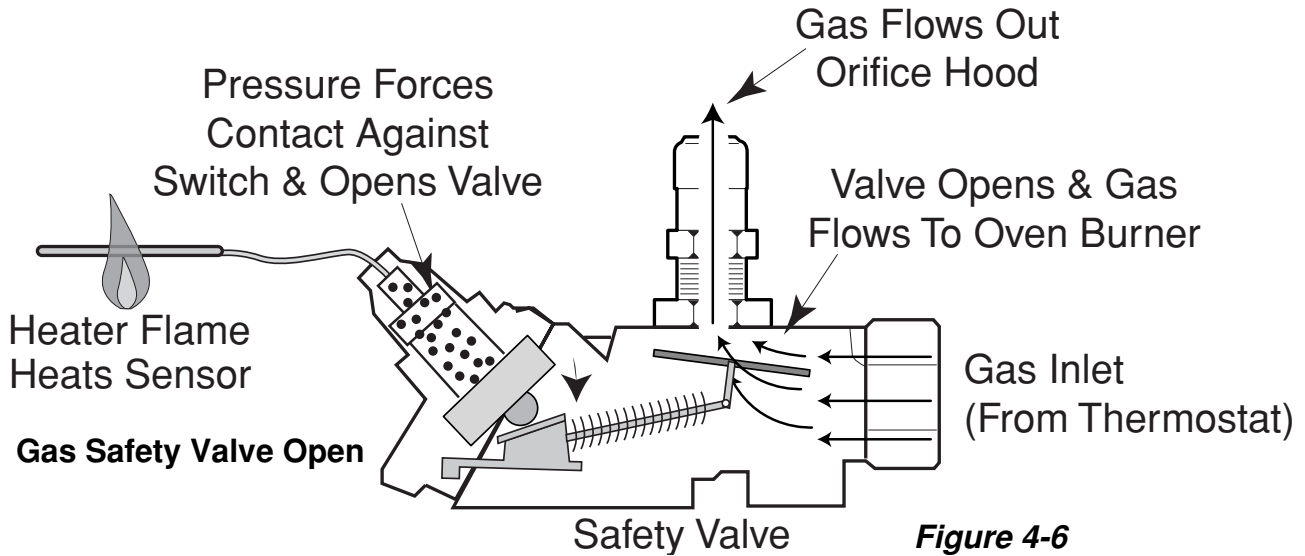
When the thermostat is turned “ON” to any temperature, its primary function is to increase the flow of gas to the oven pilot assembly so that the “standing” pilot flame enlarges to create a “larger standing pilot” or a “**heater pilot flame**.” This larger flame is deflected by a **flame spreader** (see Figure 4-5) to heat the sensing bulb from the safety valve and hydraulically open it.



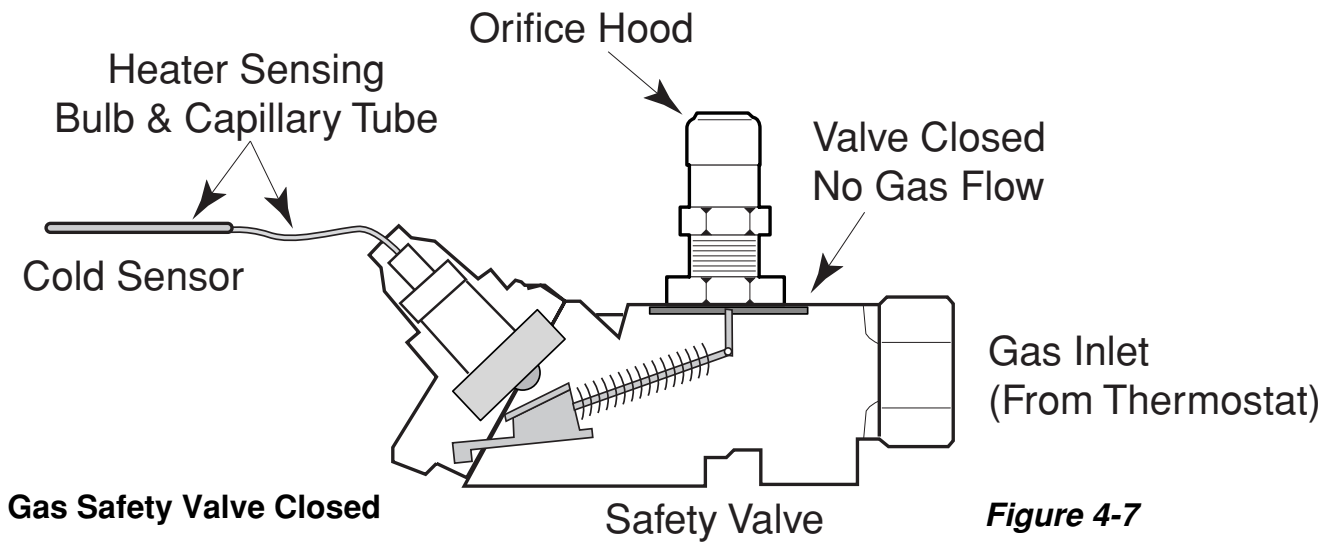
**The Standing Pilot
Thermostat On**

Figure 4-5

As this is taking place, the thermostat also opens the main gas line, and provides gas to the safety valve (see Figure 4-6). As soon as the safety valve is hydraulically opened by the signal from the sensing bulb, gas is released from the safety valve to the oven burner, and ignited by the heater pilot flame. NOTE: If the heater pilot flame is not available to heat the safety valve sensing bulb, the safety valve will not open, and gas **can not** enter the oven.



When the oven reaches the selected temperature, the sensing bulb for the thermostat closes the thermostat gas lines and reduces the heater pilot flame back to a smaller “standing pilot” flame. With no heater pilot flame, the sensing bulb for the safety valve cools, closes the safety valve, (see Figure 4-7), stops the gas supply to the oven burner, and eliminates the flame. This cycling will continue for the duration of the cooking cycle.



NOTE: The thermostat used in the Standing Pilot range needs to be converted if L.P. gas is being used. A "Nat" or "L.P." setting is located on the front face of the thermostat (see Figure 4-8 and its inset).

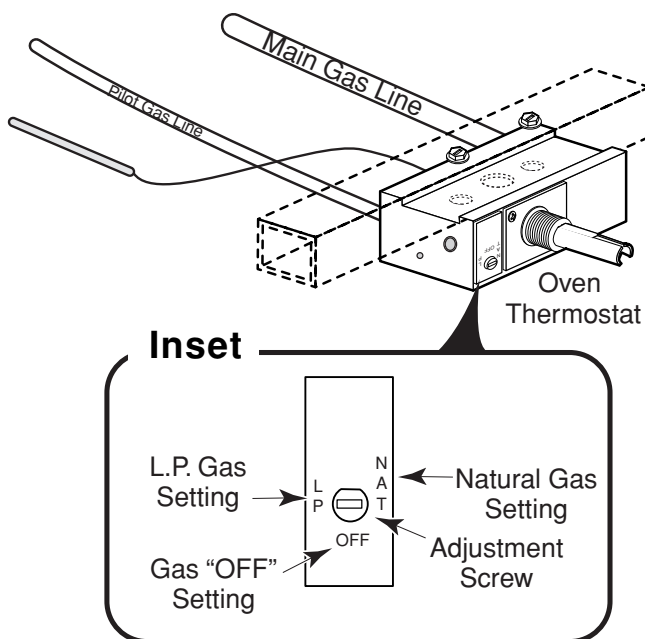


Figure 4-8

LIGHTING THE OVEN PILOT

To light the pilot, perform the following steps (see Figure 4-9):

1. Turn off all the range controls.
2. If your range is equipped with a broiler drawer, open it and wait five minutes for any gas inside the range to dissipate.
3. Remove the baffle and oven bottom.
4. Hold a lighted match near the tip of the pilot on the burner assembly until a flame appears.

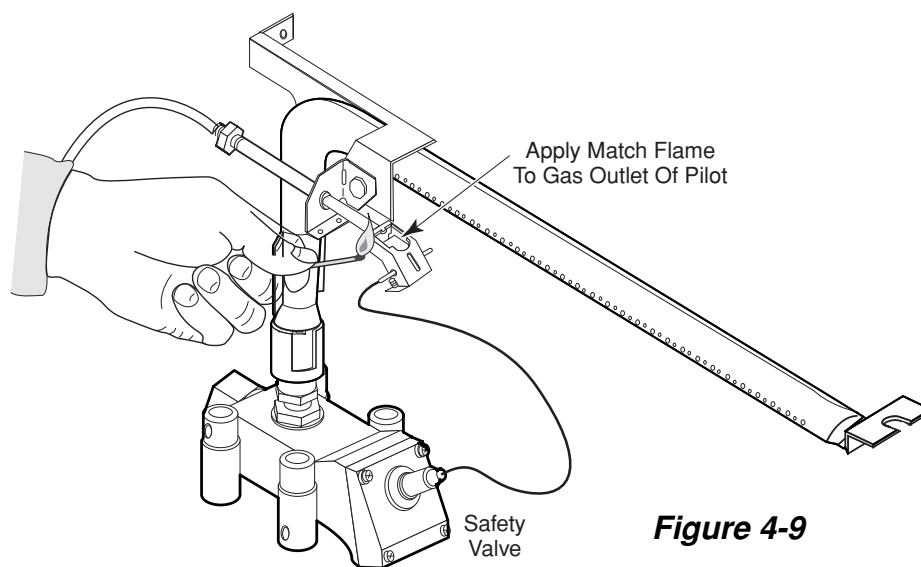


Figure 4-9

5. Replace the baffle and oven bottom.
6. Turn on the oven thermostat and allow the burner to light.

GLO-BAR IGNITION

The **Glo-Bar Ignition System** (see Figure 4-10) is a 120-volt electrical system that consists of three important components. The three components, a thermostat that is controlled by the customer, an ignitor and a safety valve, both located inside the oven, create a very efficient system that is safe and dependable. Unlike the mechanical system that works with a sensor and capillary tube to operate the safety valve, this system operates entirely on an electrical system requiring 120-volts AC (alternating current).

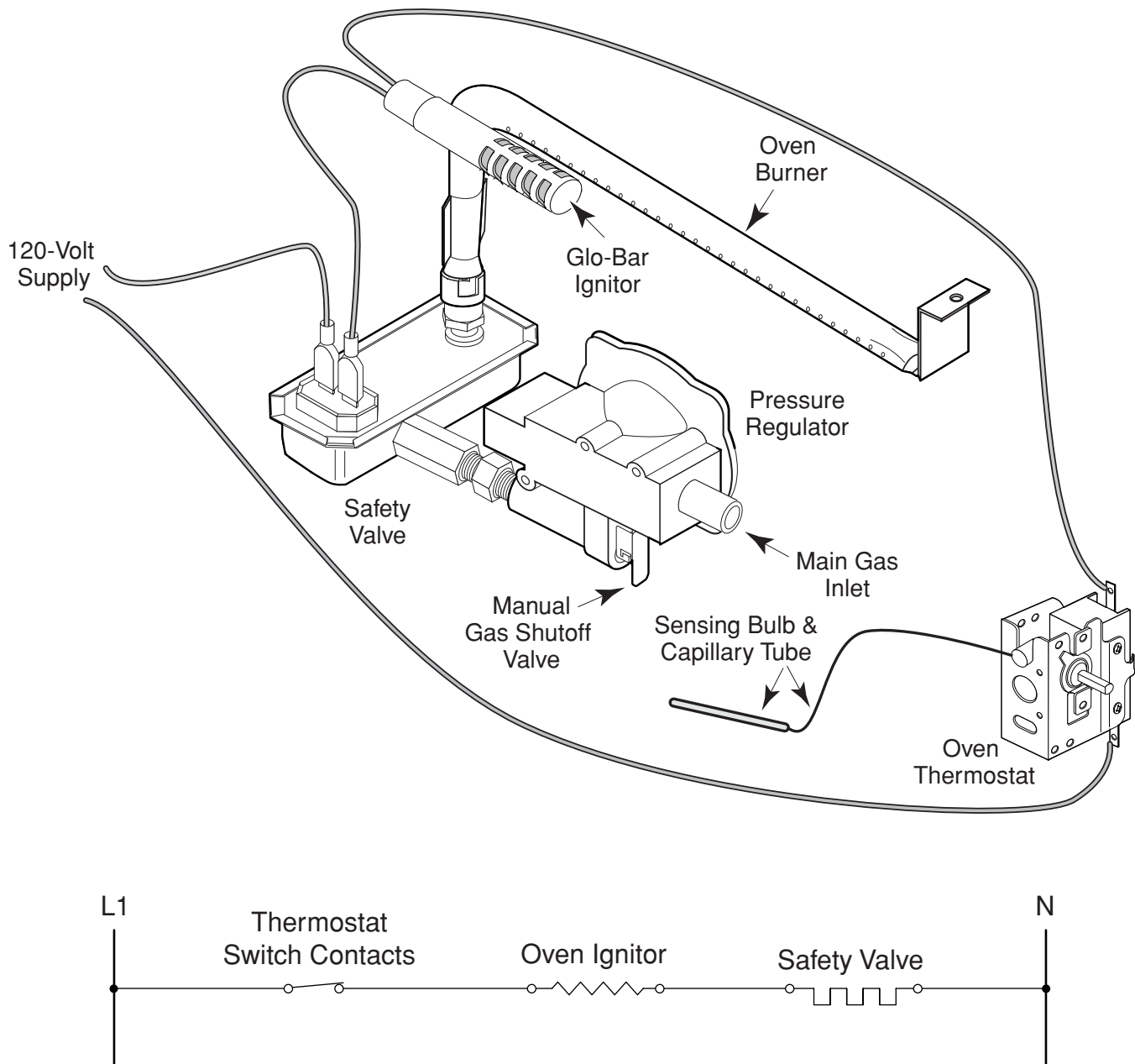


Figure 4-10

The **Thermostat** contains a set of contacts that open and close, (see Figure 4-11A), depending on the temperature selected by the customer, and the temperature monitored in the oven cavity. When the thermostat is turned to the “ON” position, contacts within the thermostat close to complete an electrical circuit (see Figure 4-11B). As the oven heats up to a selected temperature, the internal pressure within the sensing bulb increases until the thermostat contacts are forced open (see Figure 4-11C).

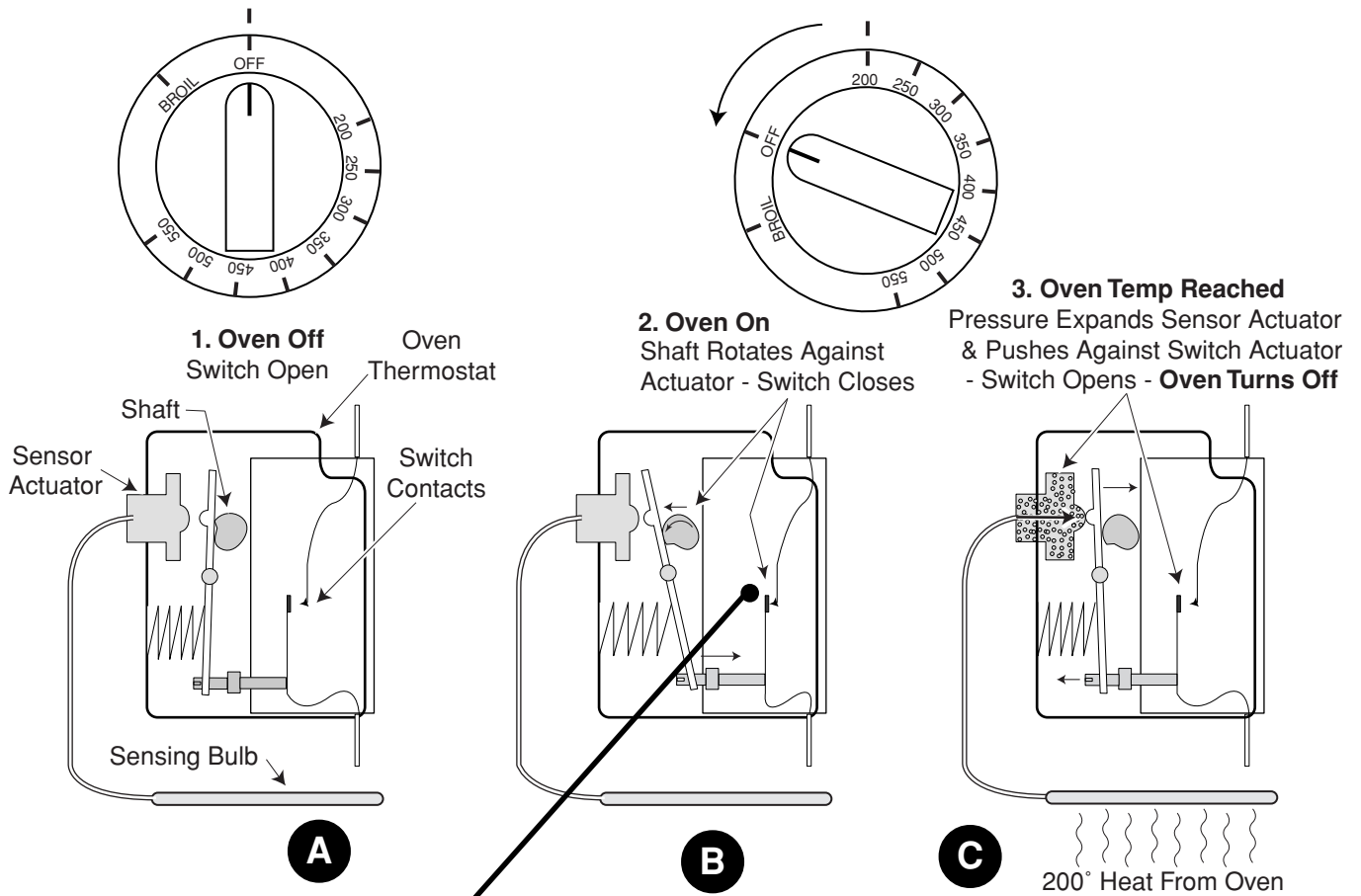


Figure 4-11

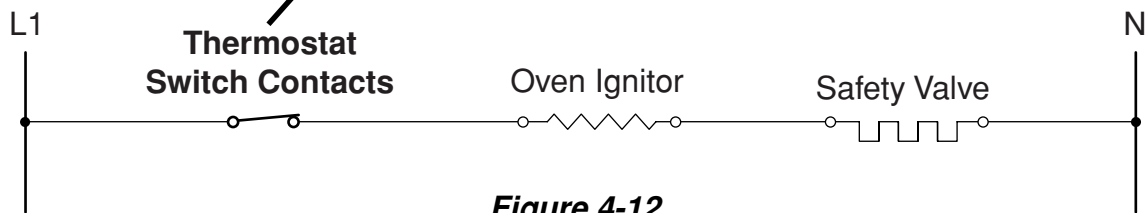


Figure 4-12

As the oven cools, the pressure from the sensor actuator decreases, and the thermostat contacts close. This cycling of the contacts opening & closing continues until the cooking function is complete. The electrical contacts of the thermostat complete an electrical circuit through the ignitor and safety valve to the neutral side of the 120-volt circuit (see Figure 4-12).

The **Oven Ignitor** is made of a silicon-carbide material (see Figure 4-13).

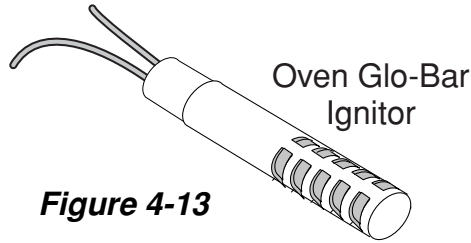


Figure 4-13

When voltage is applied to the ignitor, it heats up to 2000°F. As its temperature increases, its resistance decreases, allowing 2.5 to 3.0 amps to flow to the bimetal in the safety valve. This measurement is critical to the proper operation of the ignitor. In many cases, the ignitor can glow red, but not provide the proper amperage to the safety valve. At a room temperature of 75°F, the resistance of the ignitor should be between 50 and 1100 Ω. At room temperature the ignitor can not provide enough amperage to properly operate the safety valve (see Figure 4-14).

$$\begin{aligned} \text{Amperage} &= \text{voltage divided by resistance (cold ignitor)} \\ \text{Amperage} &= 120 \text{ volts} \div 500 \text{ ohms} \\ \text{Amperage} &= .24 \end{aligned}$$

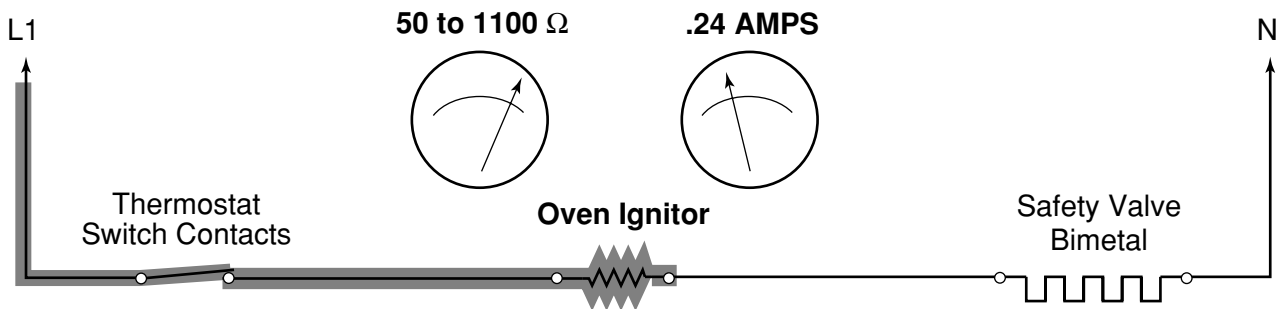


Figure 4-14

As the ignitor heats toward 2000°F, its resistance drops to approximately 40 to 45 Ω, and can then operate the safety valve (see Figure 4-15).

$$\begin{aligned} \text{Amperage} &= \text{voltage divided by resistance (hot ignitor)} \\ \text{Amperage} &= 120 \text{ volts} \div 40 \text{ ohms} \\ \text{Amperage} &= 3.0 \end{aligned}$$

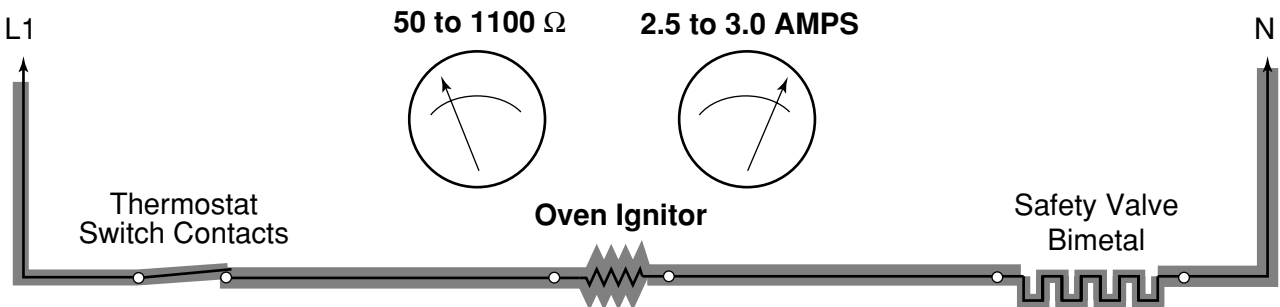
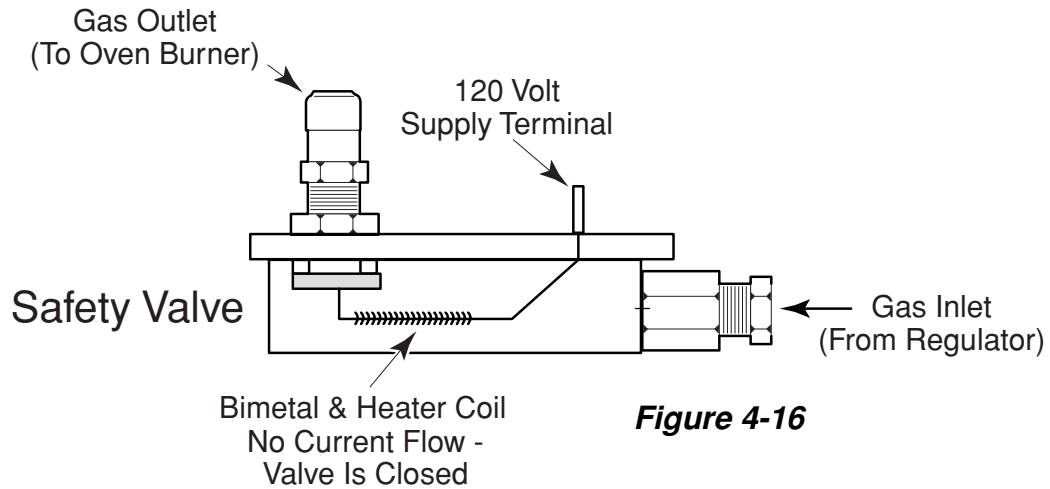
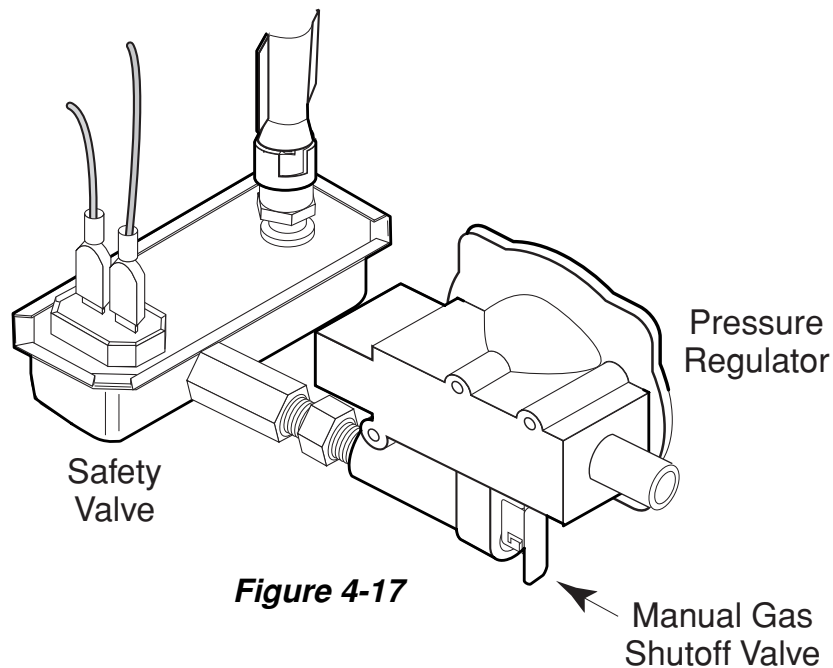


Figure 4-15

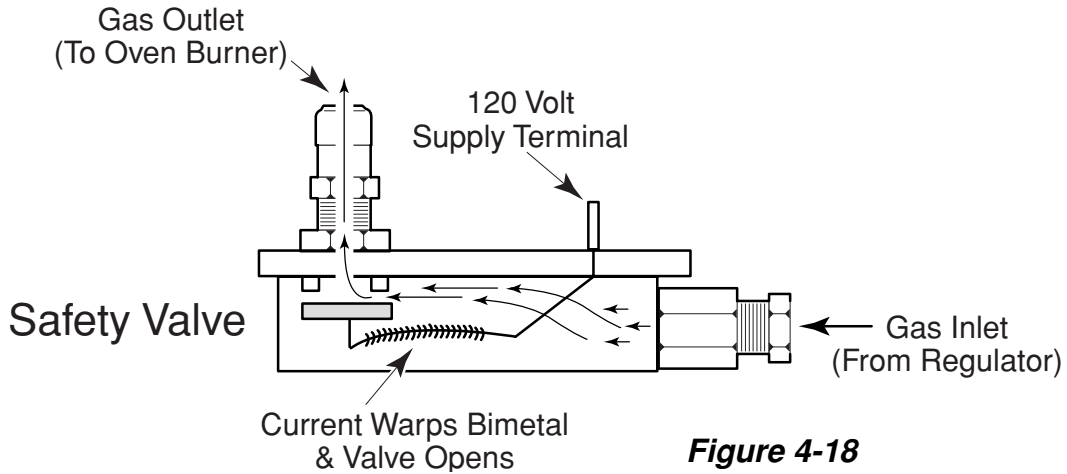
The oven uses a **Single Safety Valve** that is bimetal-operated (see Figure 4-16). It has one gas inlet and one gas outlet, for the combination Bake and Broil burner. The safety valve uses an electrically-operated device at the gas outlet to control the gas flow to the oven burner. The device consists of an electric heater coil wrapped around a bimetal strip. One end of the bimetal is riveted to the plate of the valve. The other end has a rubber seat attached to it that covers the gas outlet. At room temperature, the spring force of the bimetal presses the rubber seat against the gas outlet.



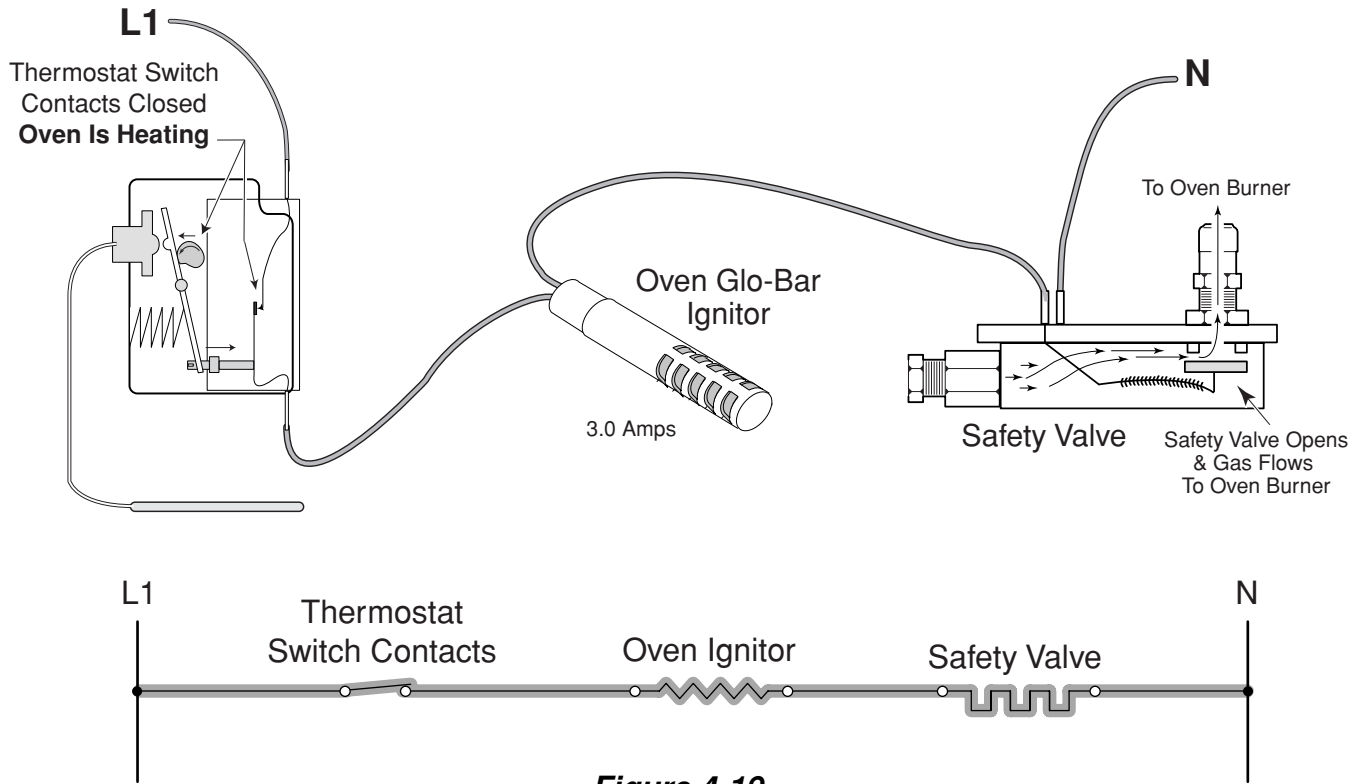
Gas is available at the safety valve at all times, but can be shut off by a manual shutoff valve on the regulator (see Figure 4-17).



When current flows through the ignitor, heat is applied to the bimetal strip. The amount of heat necessary to warp the bimetal enough to open the valve requires 3.0 amps of current flow in the circuit (see Figure 4-18). The reason the valve is designed not to open below 3.0 amps, is to insure that the temperature of the oven ignitor is above 1800°F before the valve opens. The operation of the system is complete when gas is flowing from the safety valve to the oven burner, and is ignited with the hot glo-bar ignitor. The entire process may take between 40 to 60 seconds to start.



Throughout the cooking cycle, the oven will continue to “heat up” and “cool down” to maintain the selected temperature (see Figure 4-19). This operation is controlled by the thermostat’s sensing bulb.



When the thermostat senses that the selected oven temperature is reached, its internal contacts open, as discussed earlier, and the electrical circuit is terminated (see Figure 4-20). The bimetal cools and closes the safety valve to shut off the gas flow to the oven burner. This cycling of the electrical system continues throughout the cooking cycle.

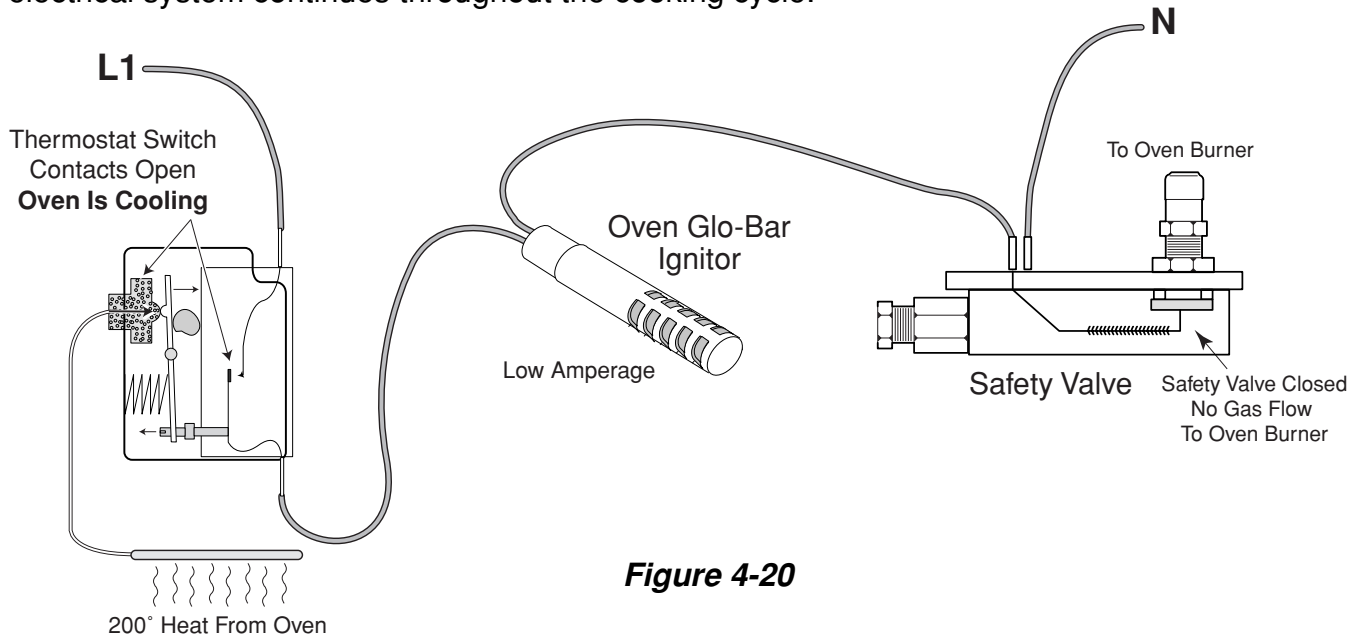


Figure 4-20

CLEANING THE OVEN BURNER

The most common burner malfunction is clogging due to excess dirt and debris, which can enter the burner through the burner ports. This excess dirt can block one or several of the ports so that the burner will have trouble lighting, or will not light at all. In this case, the burner ports must be cleared using a pin (see Figure 4-21).

The air shutter is an additional inlet where dust can enter a main burner. Whether or not the burner is operating, dust can still be drawn into the burner through the air shutter. The debris can clog the venturi, orifice, mixing tube, or burner ports. Again, this type of clogging can reduce, if not stop, the flow of gas through the burner. In addition, the primary air shutter itself can become blocked, restricting the flow of primary air into the burner.

In any event, cleaning the burner normally eliminates most of the dirt buildup. Also, it is a good practice to keep the area immediately surrounding the main burner as clean as possible to reduce the possibility of clogging any part of the main burner.

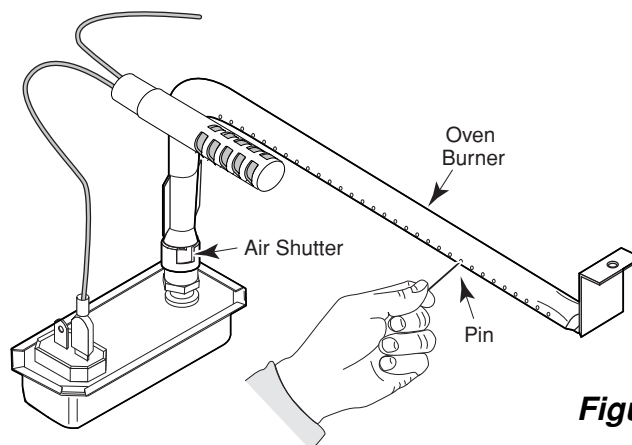


Figure 4-21

SELF-CLEANING SYSTEM

All Whirlpool Self-Cleaning Gas ranges use two burners in the oven to provide even heating during the Bake and Broil functions, and higher temperature during the Self-Clean cycle (see Figure 4-22). To provide each of these features, the system incorporates a **bake burner** that operates just like the Glo-Bar Ignition System already discussed, plus an additional **broil burner** that provides the benefit of broiling inside the same oven cavity. All Self-Clean ranges feature electronic controls, which utilize an accurate and responsive electronic sensor.

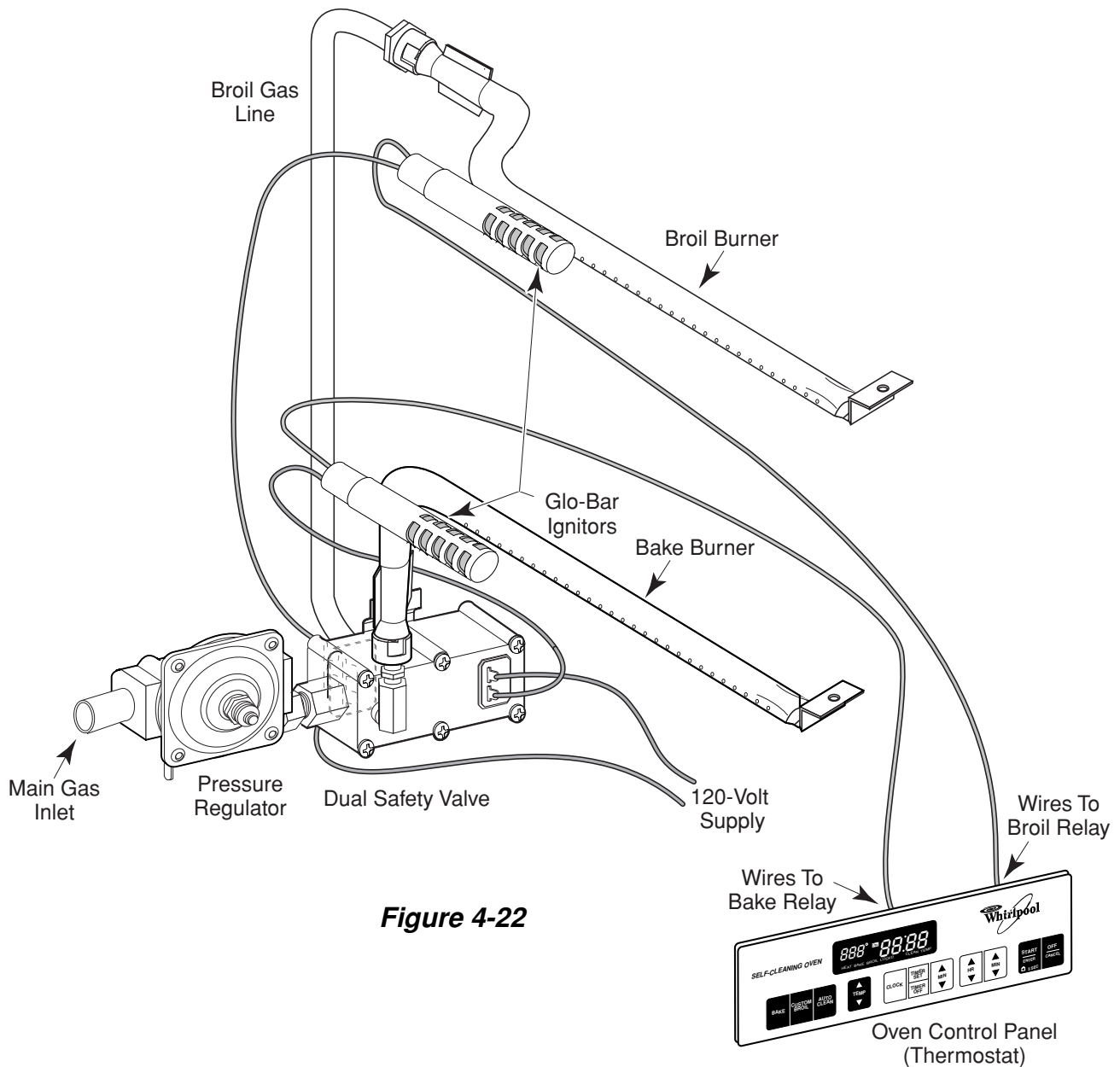


Figure 4-22

Self-Clean ovens use a dual safety valve that is bimetal-operated. The dual valve has one gas inlet and two gas outlets; one for the Bake burner and the other for the Broil burner (see Figure 4-23). It uses two identical electrically-operated devices, one for each outlet, to control the gas flow. The devices consist of an electric heater coil wrapped around a bimetal strip. One end of the bimetal is riveted to the plate of the valve. The other end has a rubber seat attached to it that covers a gas outlet. At room temperature, the spring force of the bimetal presses the rubber seat against the gas outlet.

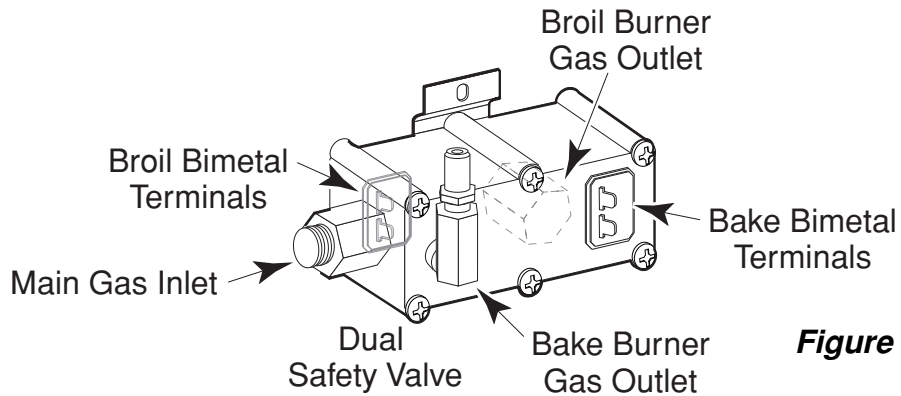


Figure 4-23

When current flows through the ignitor, heat is applied to the bimetal strip. The amount of heat necessary to warp the bimetal enough to open the valve requires 3.0 amps of current flow in the circuit (see Figure 4-24). The reason the valve is designed not to open below 3.0 amps, is to insure that the temperature of the oven ignitor is above 1800°F before the valve opens.

To prevent miswiring, the Bake terminals and Broil terminals are sized differently.

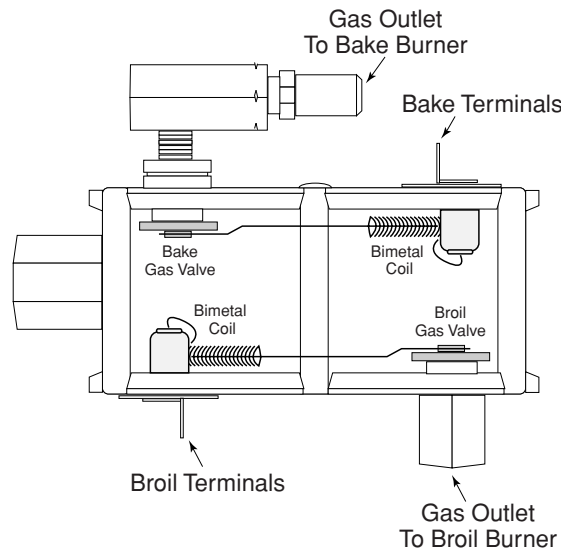


Figure 4-24

The electrical circuit is initiated by relays on the electronic control board. The electrical circuit is similar to the circuit used with the Glo-Bar Ignition System (see Figure 4-25).

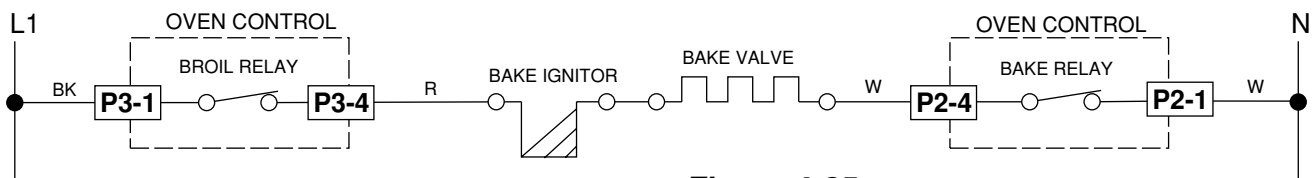


Figure 4-25

The electronic board is constructed with individual relays to operate the Bake, Broil, and Self Clean functions independently of each other. The Microcomputer board electrical diagrams (see Figure 4-26) show how opening and closing the relays operate the various customer-selected cycles.

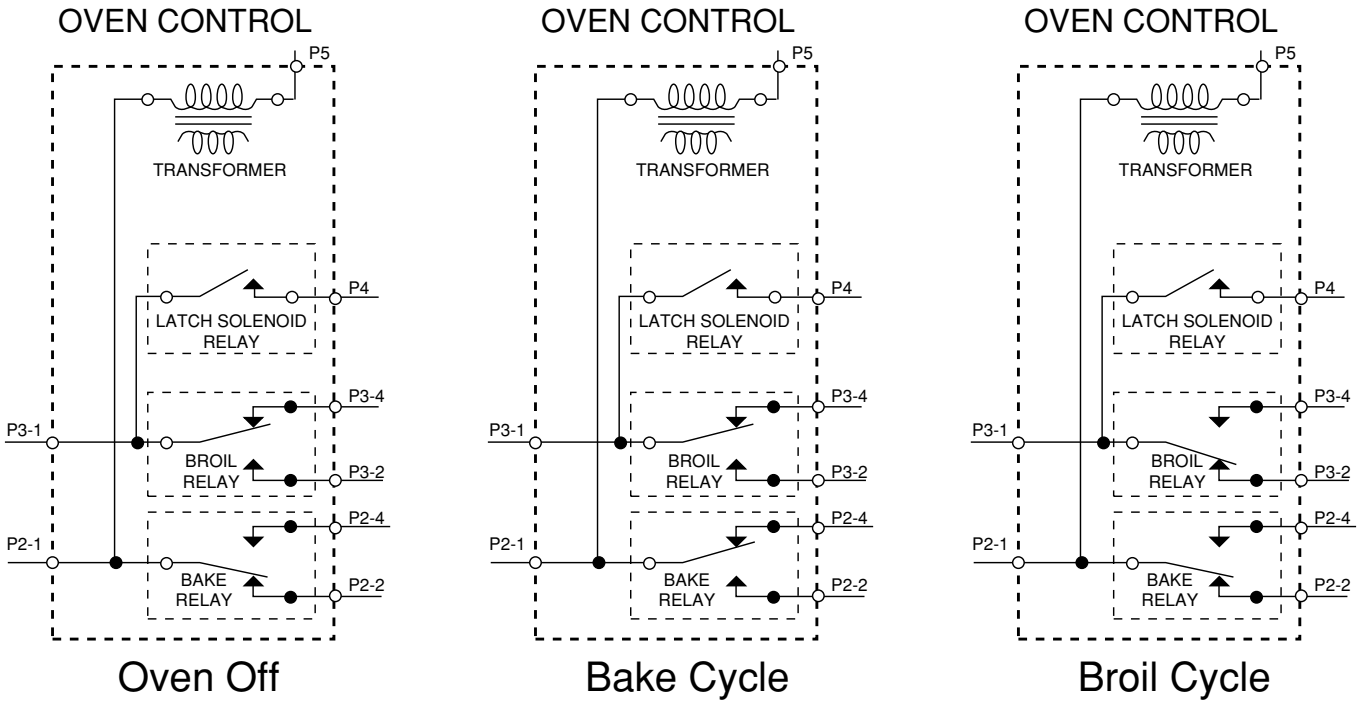


Figure 4-26

By the construction of the relays, both the Bake Function (see Figure 4-27), and the Broil function (see Figure 4-28), can not operate at the same time. The normally-closed position of the opposite relay is needed to complete the circuit.

BAKE

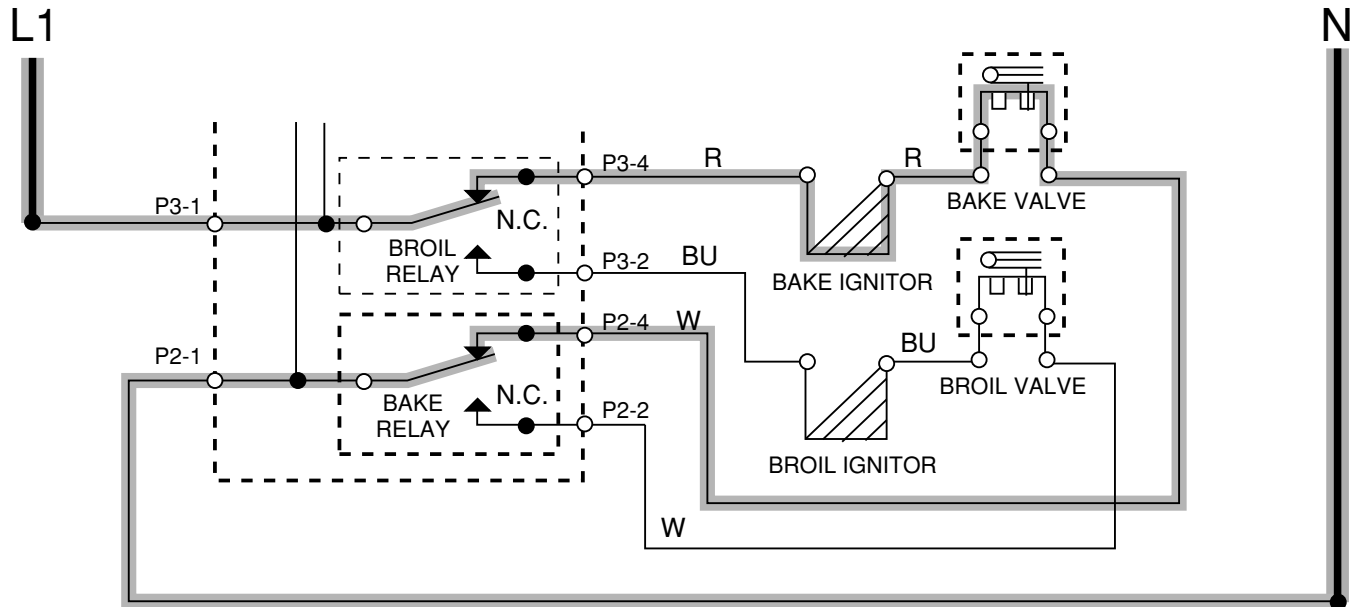


Figure 4-27

BROIL

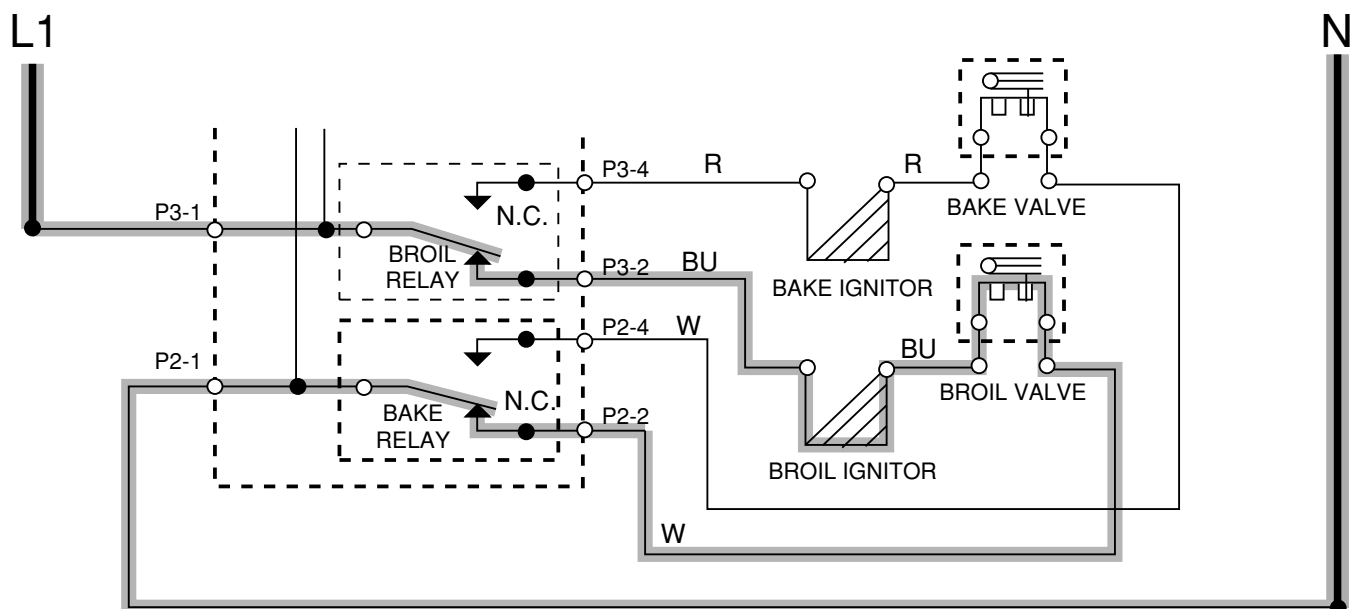


Figure 4-28

F-CODE GUIDELINES

- F0** = If the most recent F-code is recalled via user input, F0 indicates no failure has occurred.
- F1** = Electronics Subsystem Failure.
Replace electronic control board.
E0 = EEPROM communication error.
E1 = EEPROM checksum error.
E2 = A/D converter error (is there an error bit in the micro?; does this mean lost a voltage rail?).
E5 = Calibration shifted.
E9 = Stack overflow.
- F2** = Keypad Subsystem Failure. Replace keypad if properly connected and this F-code is displayed.
E0 = Shorted key / key stuck.
E1 = Keypad / keytail not connected.
E5 = Cancel key low or open.
- F3** = Cavity Temperature Sensor Failure.
Check for welded relays; if OK then replace temperature sensor.
E0 = Sensor open.
E1 = Sensor shorted.
E2 = Non-self-clean over temperature (usually 550°F).
E3 = Self-clean over temperature (usually 900°F).
- F5** = Latch Subsystem Failure.
Check for proper latch movement; check for proper switch actuation; check for proper clearance between latch and door.
E0 = Latch switch does not agree with door switch (i.e. latch in locked position with door open).
E1 = Latch will not lock.
E5 = Self-clean temperature set point not reached within required time range (usually 30 to 45 minutes).
E7 = Latch will not unlock.

NOTE: Never lock the door in association with an F-code. The door should only lock at high temperatures (usually above 550°F) or while in Self Clean. The door should unlock immediately when the cavity falls below the unsafe temperature.

PERFORMANCE CHECK

1. Remove the oven's operating system (burners, safety valves, and ignitors).

THE SELF-CLEAN OVEN DOOR LOCKING SYSTEM

At any time a range is in a self-clean operation, it needs to provide a safe environment for the customer. A self-clean cycle will reach temperatures of over 800°F during its 2- to 4-hour cycle. To prevent the consumer from accessing the oven while these extreme temperatures are present, every self-clean range is equipped with an oven door lock system. This system locks the oven door whenever the oven cavity temperature exceeds 600°F. The system can be activated by the consumer manually, using a lock lever, or electrically. Whirlpool ranges utilize an electronic locking system to assure that the range will not operate unless the oven door is safely locked during high temperatures.

The electronic system consists of:

- An electronic control.
- A door latch switch.
- A door latch solenoid.
- A door latch switch to provide feedback to the microcomputer board.
- A door latch. NOTE: The oven sensor is also a critical component of the system because it monitors temperatures needed to control the system.

The Self-Clean System begins at the control board (see Figure 4-29). As the CLEAN function is programmed into the control and the START pad is pushed, the latch relay on the microcomputer board closes for less than a second. This allows just enough time to provide a 110 volt pulse to the solenoid.

The solenoid is a spring-loaded “push-push” mechanism. As voltage is applied, the solenoid pushes against the spring-loaded plunger, and extends it. This operation only requires a pulse of electricity. As the plunger is extended, the next pulse of electricity will again push against the spring loaded plunger, and retract it. This “push-push” function can be related to the extension and retraction of a fountain pen.

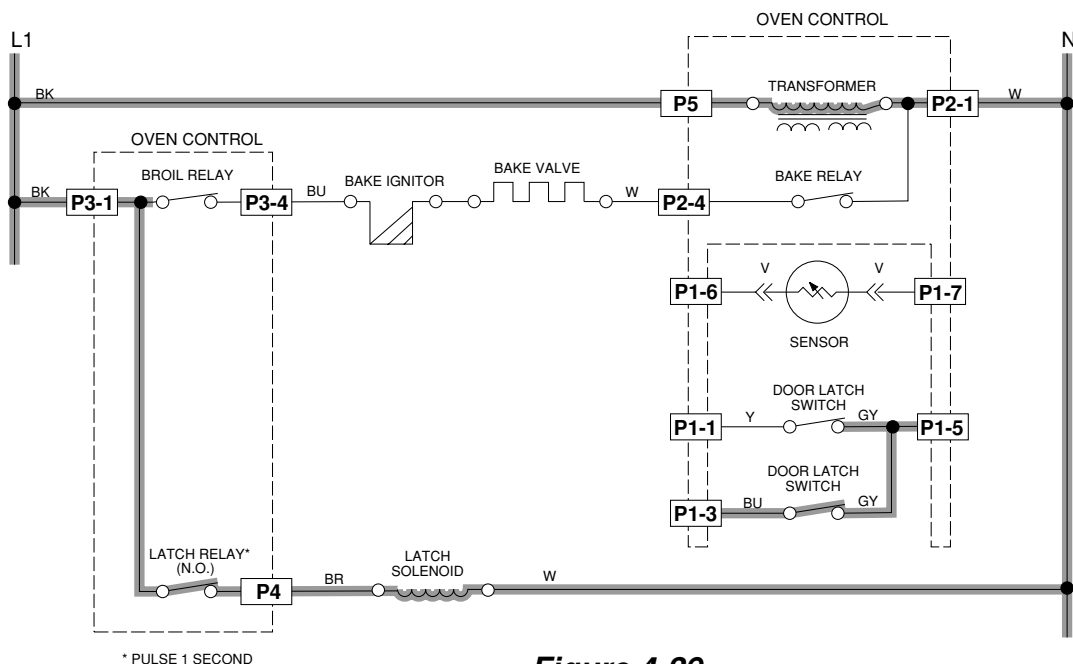


Figure 4-29

When the solenoid plunger extends, two things happen (see Figure 4-30). As the latch solenoid locks the door, it also activates the two door latch switches. Both door switches are normally-open switches. As the solenoid moves to lock the door, the switches toggle, and:

- a) Open the oven light circuit so that the light cannot be operated during the Clean function.
- b) Provide a logic circuit for the electronic board to indicate that the door is locked and that the Clean cycle can continue.

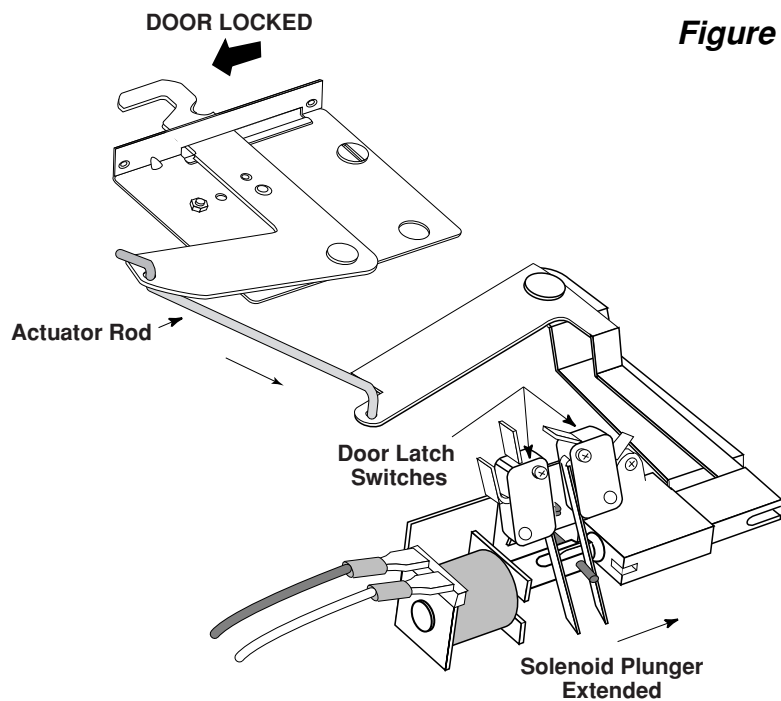
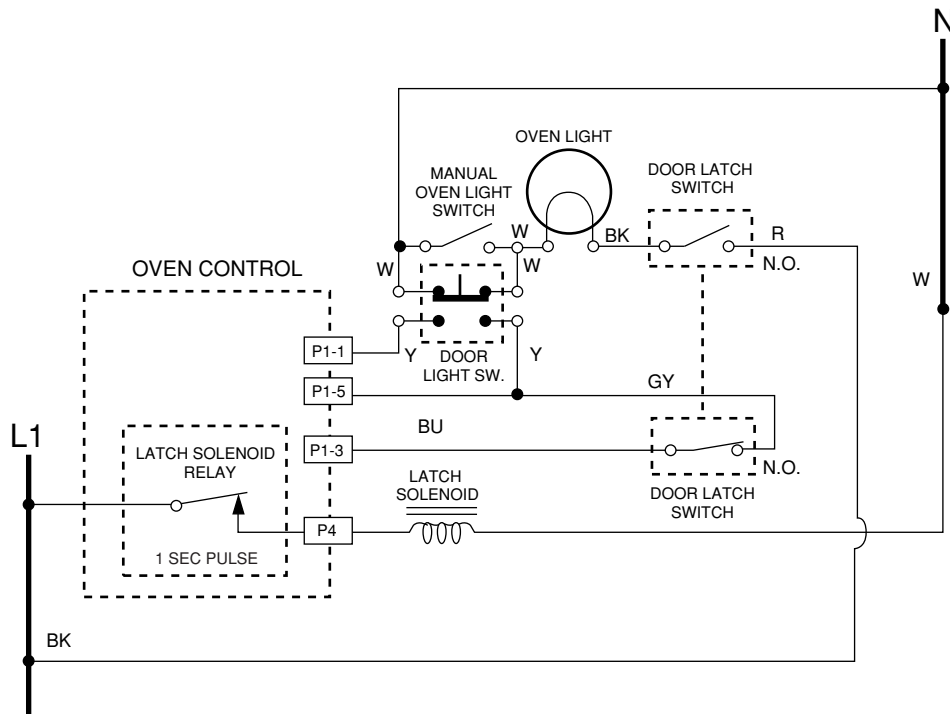


Figure 4-30

When the oven temperature reaches 600°, the oven door cannot be opened until the oven cools down to below 550°. At that point, the latch solenoid relay will close for just a second, and provide a 120 VAC pulse to the latch solenoid (see Figure 4-31). This unlocks the door and toggles the door latch switches to their normal state.

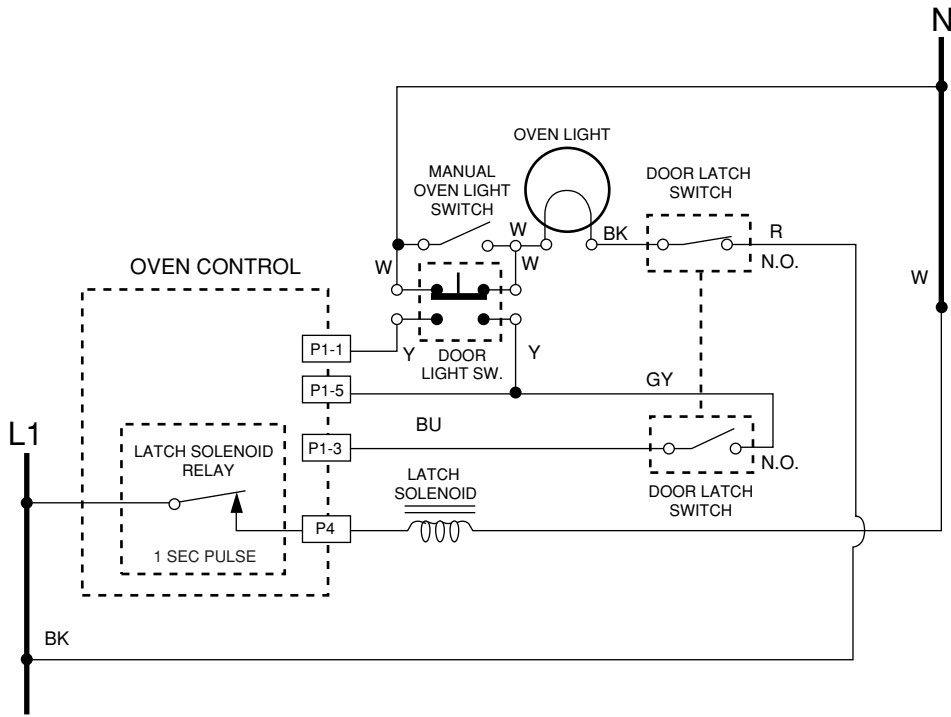
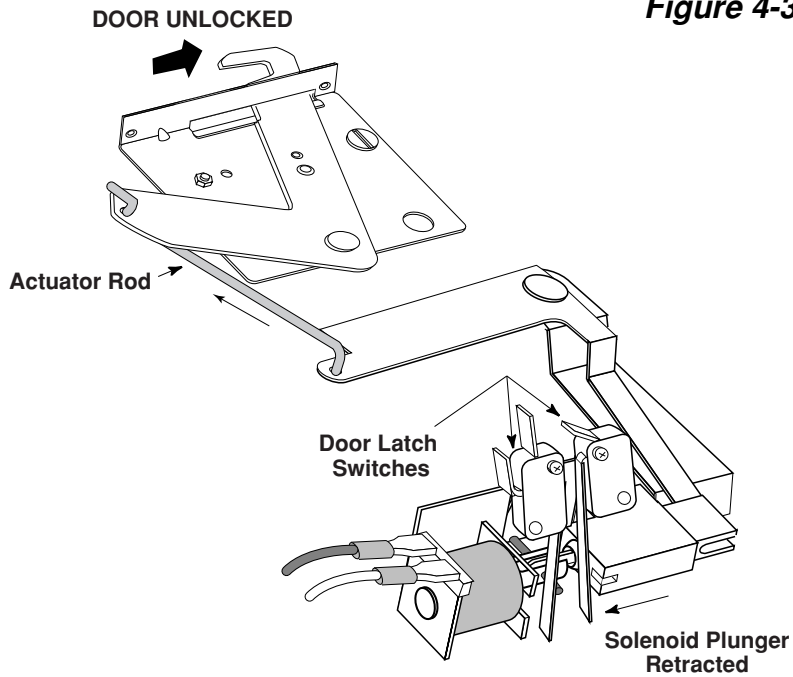


Figure 4-31



NATURAL AND L.P. GAS CONVERSION

GENERAL

Ranges must be adjusted when going from one type of fuel to another due to the characteristics of the gases. This means that, for efficient combustion, air must be mixed with the gas. The amount of air to be mixed with the amount of gas is called the ***air-to-gas ratio***. The combustion ratio is different between natural and L.P. gas. L.P. gas requires much more air (24:1) to be mixed with it than natural gas (10:1).

Also, there are differences in ***caloric values*** between the gasses. When a cubic foot of L.P. gas is burned, it produces much more heat than the same volume of natural gas. This is why the burner orifices must be changed to restrict the gas flow when converting to L.P. use. In other words, the range uses less fuel and more air with L.P. gas to create the same amount of heat with natural gas.

L.P. gas is also distributed and used at higher pressure (11 "WCP) than natural gas (4 "WCP). This is why the pressure regulator must be converted when changing from natural gas to L.P. operation (refer to the following chart).

	<i>NATURAL</i>	<i>PROPANE</i>	<i>BUTANE</i>
CHARACTERISTICS	Colorless, Odorless, Non-Toxic, Gaseous (Oxidizer Added)		
B.T.U./Cu. Ft.	900 to 1100	2500	3010
Combustion Ratio Cu. Ft. Air/Cu. Ft. Gas	10	24	31
Operating Pressures: Manual Service Range	8.25 PSI 5" - 14" WCP 4" WCP	Not Applicable 11" - 15" WCP 10" WCP	Not Applicable 11" - 15" WCP 10" WCP
GAS CHARACTERISTICS Change Regulator Orifices & Air Shutters Due To Differences In Gasses			

RANGE TYPE	REGULATOR	COOKTOP BURNER SPUDS	OVEN BURNERS	THERMOSTAT	AIR ADJUST
NON SELF-CLEAN	X	X	1	X	X
SELF-CLEAN	X	X	2		X
COOKTOPS WITH CONVENTIONAL BURNERS	X	X			X
COOKTOPS WITH SEALED BURNERS	X	X			

CONVERTING A PRESSURE REGULATOR

By varying the tension of the regulator spring, the gas outlet pressure can be controlled for natural and L.P. gas. The regulator spring tension is adjusted by reversing the spring retainer (see Figure 5-1A) or the regulator cap (see Figure 5-1B).

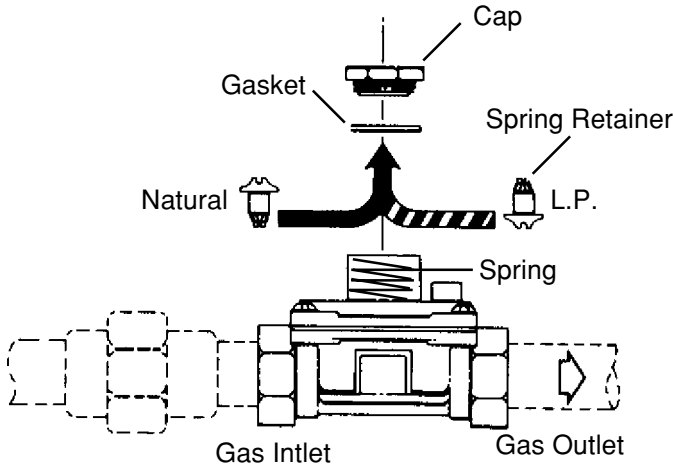


Figure 5-1A

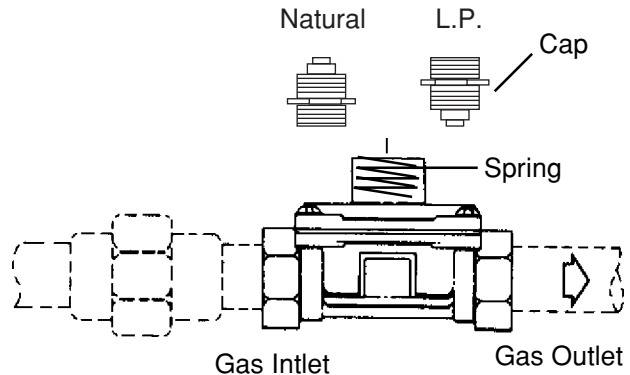


Figure 5-1B

CONVERTING COOKTOP BURNERS

The cooktop burners can be converted from natural to L.P. gas operation by changing the orifice spuds on the gas valves. The L.P. orifice spuds are packed in the literature package that is shipped with the range. Always make sure that the correct spud is installed in the valves at the proper location (see Figure 5-2). The spuds are color-coded and identified with an orifice opening number stamped on top.

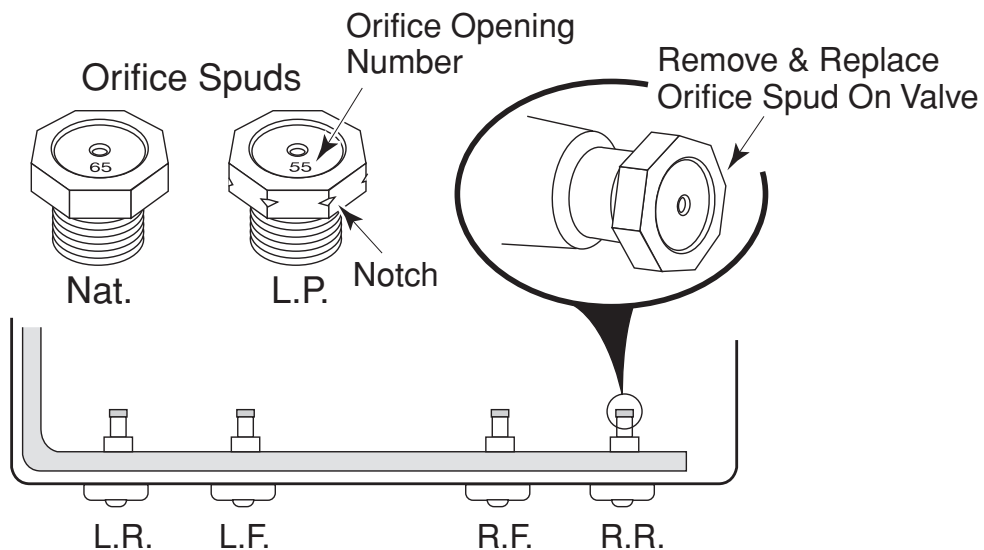


Figure 5-2

CONVERTING AN OVEN BURNER

The oven burners use universal orifice hoods. To convert the oven burners, use a 1/2" combination wrench and turn the orifice hood 2 to 2-1/2 turns so it is just against the L.P. orifice inlet. DO NOT OVERTIGHTEN the hood, or you will damage the inlet. The burner flame cannot be properly adjusted if this conversion is not made. In self-cleaning ovens, both burners must be converted using the same procedure (see Figures 5-3A and 5-3B).

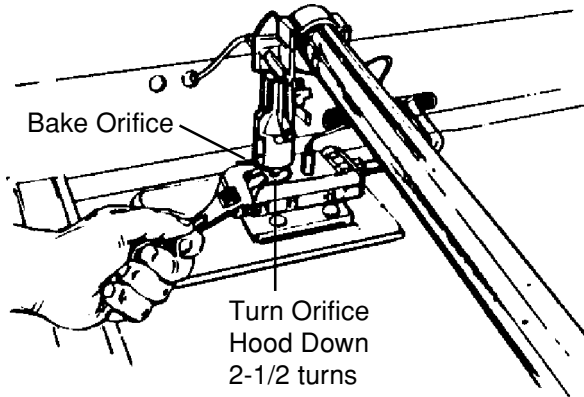


Figure 5-3A

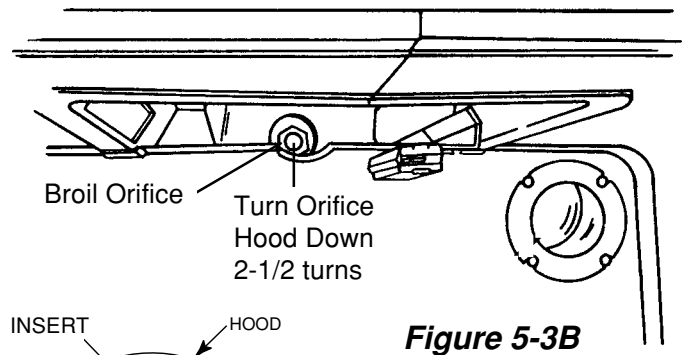
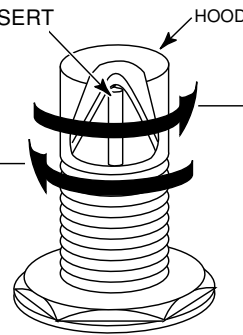


Figure 5-3B

L.P. GAS:
DECREASES GAS
AND FLAME SIZE
IN THIS DIRECTION



NATURAL GAS:
INCREASES GAS
AND FLAME SIZE
IN THIS DIRECTION

CONVERTING AN OVEN THERMOSTAT

If the range is equipped with a standing pilot in the oven, an adjustment for the pilot must be made. The gas for the oven's standing pilot is supplied by the oven thermostat. Thermostats used on standing pilot ranges have a screw to adjust for natural or L.P. gas (see Figure 5-4). Turn the adjustment screw to the correct setting for the type of gas being used in the oven.

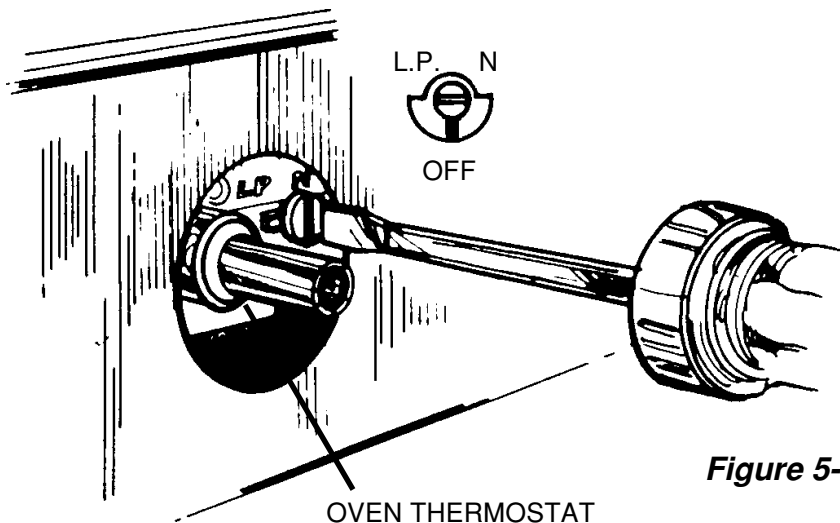


Figure 5-4

BURNER FLAME ADJUSTMENT

After converting the range to L.P. gas operation, it may be necessary to adjust each burner flame (cooktop and oven burners). A proper cooktop burner flame should be approximately 5/8" high and have a well-defined blue flame. The oven burner flame should be approximately 3/4" high and have a distinct blue flame. If the flame is noisy, or blowing off the burner, it is getting too much air. If the flame is soft and lazy, it is not getting enough air. Air adjustments can be made by adjusting the air shutter at each burner (see Figures 5-5A, B, & C). NOTE: There is no air adjustment for sealed burner cooktops.

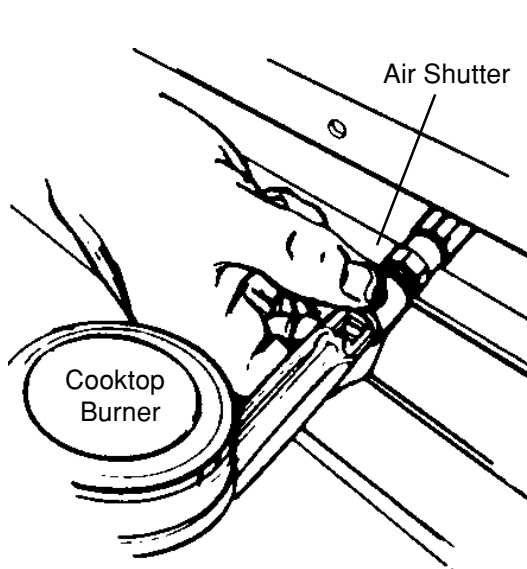


Figure 5-5A

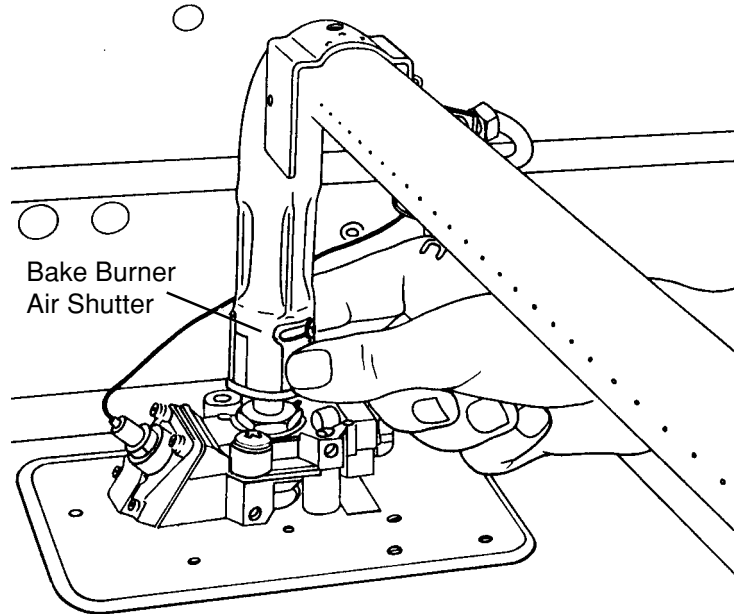


Figure 5-5B

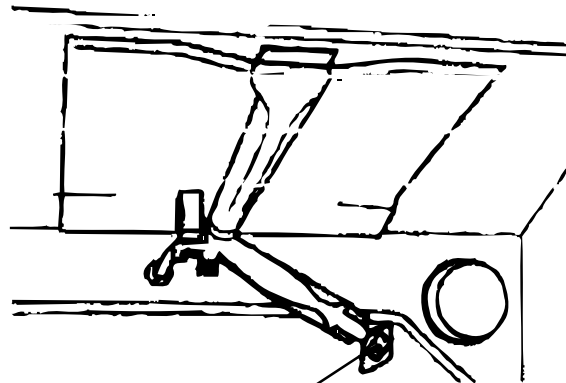


Figure 5-5C

PERFORMANCE CHECK

1. Convert the pressure regulator, cooktop and oven burners, for use with L.P. gas.



— NOTES —

TESTING THE COMPONENTS

WARNING LABELS


This manual is intended for factory-service technicians only. We recommend that customers DO NOT service their own units, because of the complexity and risk of high-voltage electrical shock.


The following information should be read carefully.



 WARNING

<p>Electrical Shock Hazard It is the customer's responsibility: To contact a qualified electrical installer. To assure that the electrical installation is adequate and in conformance with National Electrical Code, ANSI/NFPA 70 — latest edition*, and all local codes and ordinances. Failure to follow these instructions could result in death or serious injury.</p>



Copies of the standards listed may be obtained from:

* National Fire Protection Association
Batterymarch Park
Quincy, Massachusetts 02269

 WARNING
<p>Injury Hazard Securely fasten oven to cabinet using the two screws provided. Failure to follow this instruction could cause the oven to move or tip during use and result in injury.</p>

 WARNING
<p>Injury Hazard Use both hands to remove oven door. Do Not use handle or any portion of the front frame or trim for lifting. Because of the weight and size of the oven, two or more people are needed to move and safely install the oven. Failure to properly grasp the oven door or to lift oven properly could result in serious injury.</p>

 WARNING

<p>Electrical Shock Hazard Electrical ground is required on this oven. Do Not ground to a gas pipe. Do Not have a fuse in the neutral or grounding circuit. A fuse in the neutral or grounding circuit could result in electrical shock. Check with a qualified electrician if you are not sure oven is properly grounded. Failure to follow these instructions could result in death or serious injury.</p>

 WARNING

<p>Electrical Shock Hazard Electrical ground is required on this oven. Do Not connect to the electrical supply until the oven is permanently grounded. Disconnect power to the junction box before making the electrical connection. This oven must be connected to a grounded, metallic, permanent wiring system. Failure to follow these instructions could result in death or serious injury.</p>

GENERAL INFORMATION

1. When diagnosing a problem, always begin by checking the range for the proper line voltage, open fuses, and defective components.
2. New ranges that have been in operation for only a short time should be checked for loose connections or incorrect wiring.
3. When using a test meter, use one that has a sensitivity of 20,000 ohms-per-volt, or greater.
4. The ranges described in this section have spark ignition top burners, and silicon carbide (glow-bar) oven igniters with combination bake and broil burners.
5. The following pages provide a general procedure for troubleshooting each of the major components in the range. The component locations are shown in Figure 6-1.

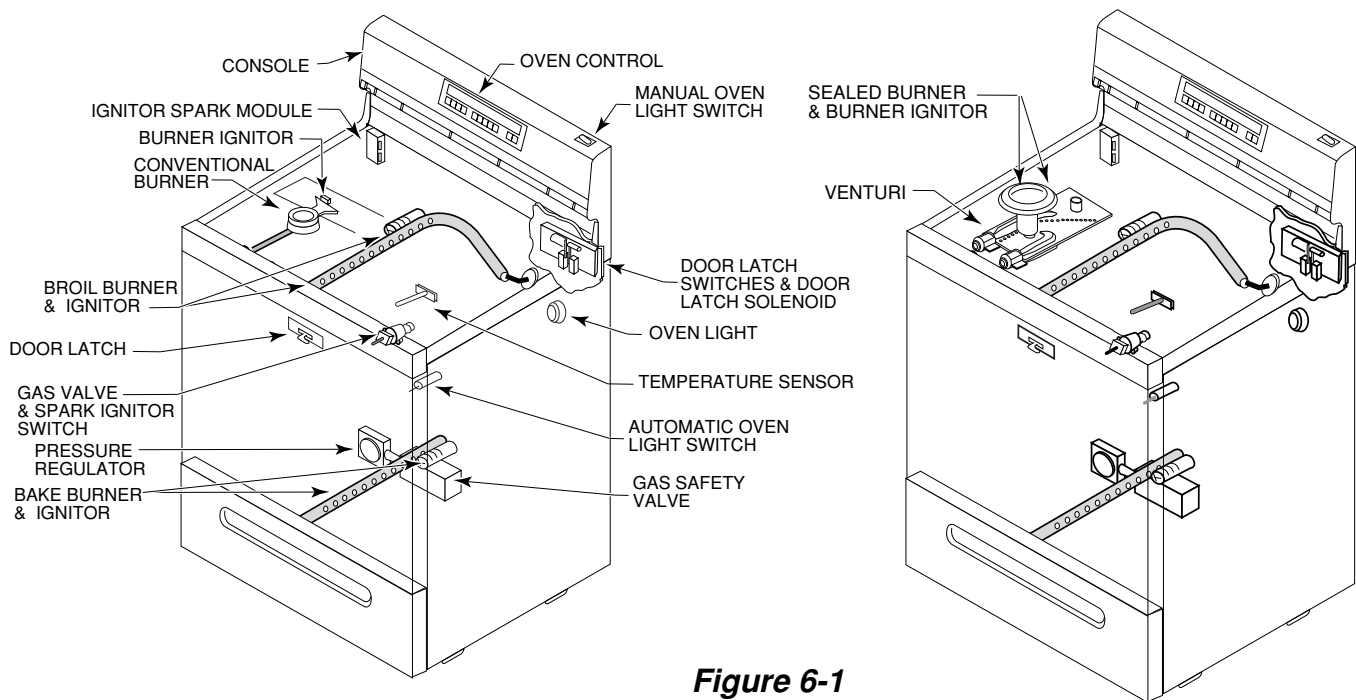


Figure 6-1

TESTING AN OVEN GLO-BAR IGNITER

If the glo-bar ignitor (see Figure 6-2) does not glow, perform the following steps to test it:

1. Turn off the gas and electrical power to the range.
2. Disconnect the oven igniter quick-disconnect plug from the main harness connector.
3. Connect an ohmmeter across the wire ends or terminals of the glo-bar. If the meter reads over 1100 Ω , replace the igniter.

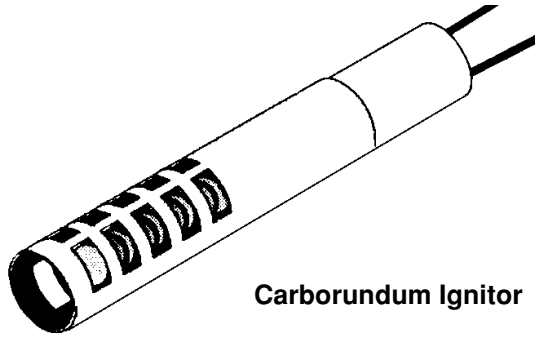


Figure 6-2

Carborundum Ignitor

Steady State Current = 3.0 Amps @ 115 \pm 1 VAC @ 75°F \pm 10° Ambient.

Cold Resistance = 500 Ω TO 1100 Ω @ 75°F \pm 10° Ambient.

Maximum Operating Temperature Not To Exceed 2650°F @ 115 \pm 1 VAC @ 75°F \pm 10° Ambient.

TESTING AN IGNITOR SWITCH

The ignitor switch (see Figure 6-3A) is located on the gas control valve stem and closes when the knob is turned to the LITE position (see Figure 6-3B) to provide power to the ignitor spark module. To test a switch:

1. Turn off the gas and electrical power to the range.
2. Disconnect the wires from the ignitor switch terminals.
3. Set the ohmmeter to the R x 1 position.
4. With the control knob in the OFF position, touch the meter leads to the switch terminals. The meter should indicate **no continuity**.

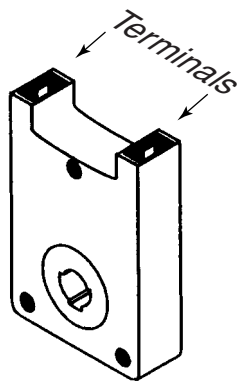


Figure 6-3A

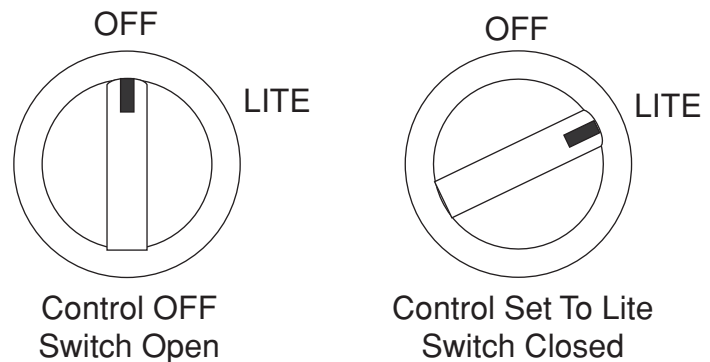


Figure 6-3B

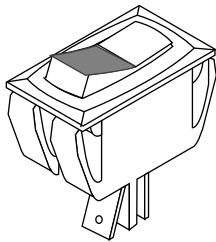
5. Turn the control knob to the LITE position, and the meter should indicate **continuity**. If the readings are not as indicated in the test, replace the switch.

TESTING AN OVEN LIGHT SWITCH

The oven light switch can be a rocker-type, (see Figure 6-4A), or a pushbutton-type (see Figure 6-4B) switch. The rocker switch is manually operated, and the pushbutton switch is operated by the oven door. The pushbutton switch may have more than two terminals, depending on the model. The terminal callouts for the two types of pushbutton switches are shown below. NOTE: It may be necessary to pull the range out of its location.

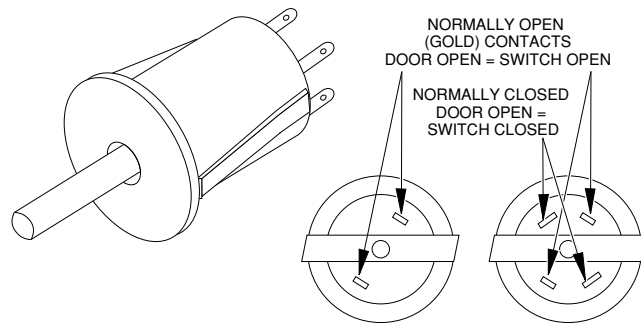
To test a switch:

1. Turn off the gas and electrical power to the range.
2. Set the ohmmeter to the R x 1 position.
3. Touch the meter leads to the rocker or pushbutton switch terminals and operate the switch. The meter should switch between **continuity** and **no continuity** as the switch is operated (see the following illustrations). If the meter does not indicate a change, replace the switch.



Rocker Switch

Figure 6-4A



Pushbutton Switch

Figure 6-4B

TESTING AN OVEN TEMPERATURE SENSOR

Some oven controls use an oven temperature sensor (see Figure 6-5) to operate the bake, broil, and self-clean functions. The oven temperature sensor is a “Resistance Temperature Detector (RTD)” and is composed of a stainless steel tube with a thin film of platinum on the end. The sensor is usually located inside the oven cavity at one of the upper rear corners. The RTD is nonadjustable, but it may be checked with an ohmmeter at various temperatures. To test a switch:

1. Turn off the gas and electrical power to the range.
2. Unplug the connector from the oven temperature sensor.
3. Set the ohmmeter to the R x 10 position.
4. Touch the meter leads to the plug pins. The meter should indicate approximately 1100 Ω at 75 °F. For resistances at other temperatures, refer to the chart below. NOTE: The readings are approximate.

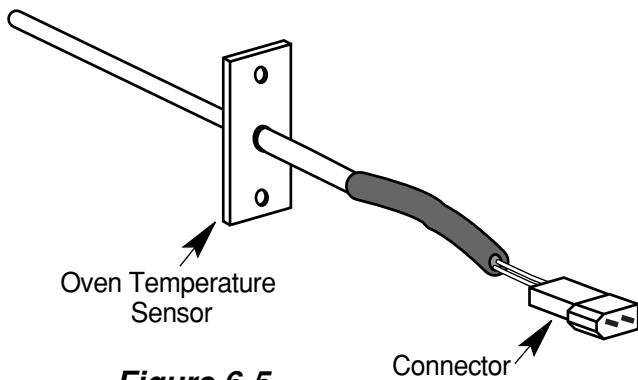


Figure 6-5

<u>Temperature (°F)</u>	<u>Resistance (Ω)</u>
32	1000
75	1100
250	1450
350	1650
450	1850
550	2050
650	2230
900	2700

TESTING AN OVEN DOOR LATCH

Gas ranges that have a self-clean feature incorporate an oven door latching system, (see Figure 6-6), which locks the oven door during the self-clean cycle. The door latch assembly consists of a solenoid and one or two switches.

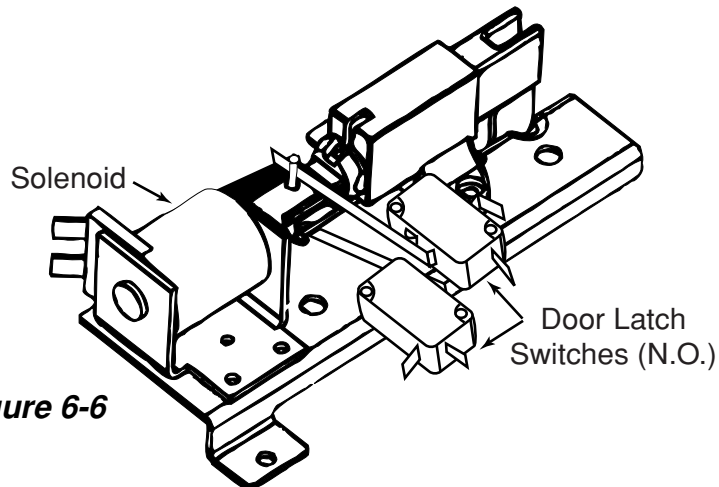


Figure 6-6

To test the solenoid windings, perform the following steps:

1. Turn off the gas and electrical power to the range.
2. Set the ohmmeter to the R x 1 position.
3. Remove the wire from either solenoid terminal (see Figure 6-7).
4. Touch the ohmmeter leads to the terminals of the solenoid. You should obtain a reading of between 40 Ω and 70 Ω .

If the reading is not within the range shown, the solenoid may be considered defective and should be replaced.

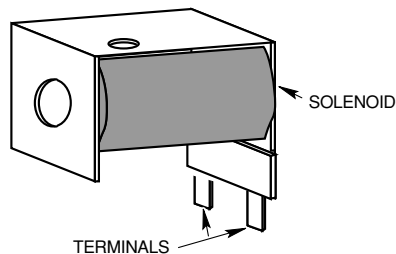


Figure 6-7

To test the switch(es):

1. Turn off the gas and electrical power to the range.
2. Disconnect the wires from the switch terminals.
3. Set the ohmmeter to the R x 1 position.
4. Connect one of the ohmmeter leads to the common (COM) terminal.
5. Touch the other ohmmeter lead to the normally-open (N.O.) switch terminal. The ohmmeter should indicate infinity (∞), or an open circuit.
6. Close the switch and the ohmmeter should now indicate continuity (0Ω).

If the above results are not obtained, the switch is defective and should be replaced.

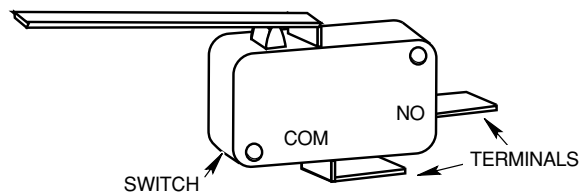
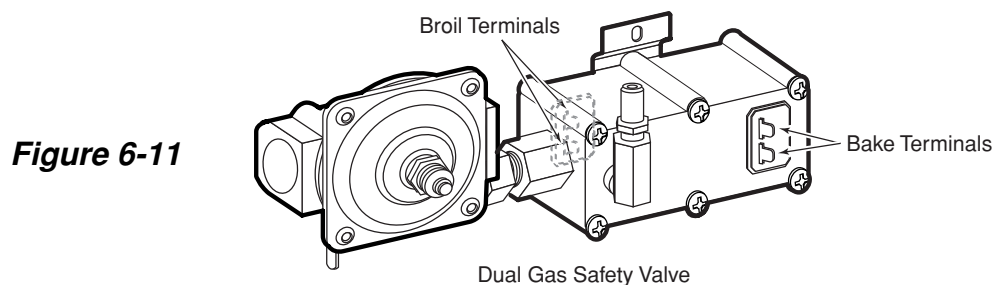
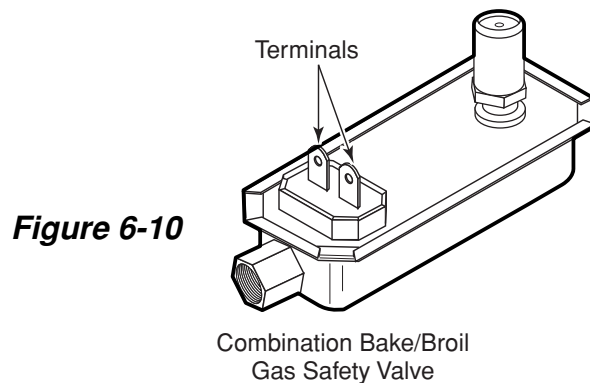
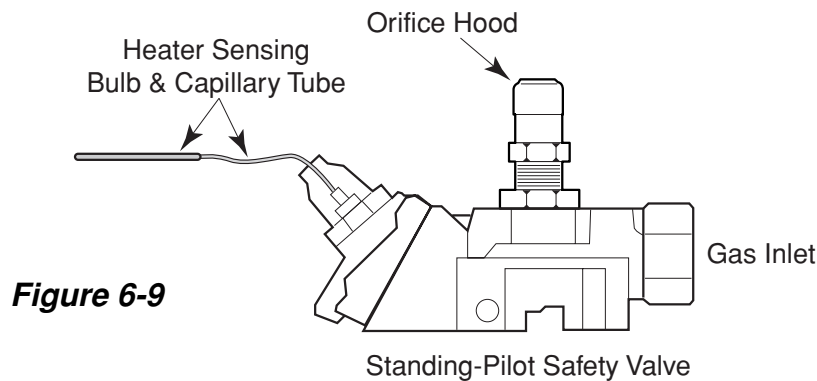


Figure 6-8

TESTING A GAS SAFETY VALVE

Some gas ranges use an electrically-controlled gas safety valve to control the flow of gas to the oven burner. The electric safety valve controls the gas flow by means of a bimetal-controlled diaphragm. Self-clean models have a single inlet, dual outlet, bimetal-operated safety valve. To prevent miswiring, the bake and broil terminals are sized differently. Several typical safety valves are shown in Figures 6-9 through 6-11. To test a gas safety valve:

1. Turn off the gas and electrical power to the range.
2. Set the ohmmeter to the R x 1 position.
3. Disconnect the wires from the bake and broil terminals.
4. Touch the meter leads to each set of terminals. The meter should indicate a low resistance reading of between 1Ω and 5Ω . If the meter indicates an open circuit, or a high resistance, replace the valve.



TESTING THE GAS CONTROL VALVES

The top burner gas valves control the gas flow to the top burners. The valve is a barrel and core, grease sealed, locking type valve (see Figure 6-12). Before the stem can be turned, it must be pushed in to unlock the valve. Gas flows from the manifold pipe into the rear of the valve and enters into the hollow core. The core has one large and two small holes in its side. When the stem of the valve is rotated, the core rotates with it. As the core is rotated, gas is allowed to flow from the large hole into the mixer elbow.

When the core is rotated 90-degrees, the large hole in the core matches the hole in the barrel allowing the maximum amount of gas to flow. When the core is rotated past 90°, the gas flow is reduced.

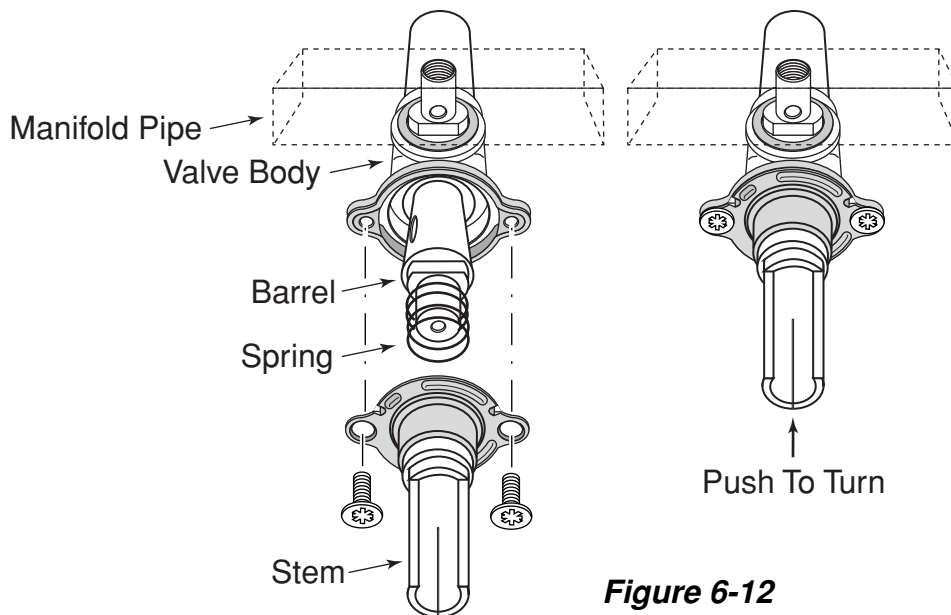


Figure 6-12

To test a gas control valve:

1. Gas leak at the valve.
 - a) Check to see if either the knob or the valve stem is rubbing the control panel. If so, align the manifold pipe before replacing the valve. If the alignment is good, replace the valve.
- Note: Any type of side pressure on the valve stem will cause the valve to leak.
2. The valve stem is hard to turn, or cannot be turned.
 - a) Check to see if the control panel is preventing the stem from being pushed in. If so, adjust the manifold pipe. If not, replace the valve.

TESTING THE GAS PRESSURE REGULATOR

The pressure regulator is a mechanical device that reduces the higher incoming gas pressure to a lower outgoing pressure, and maintains a steady, even flow of gas.

The pressure regulator has one outlet that is connected directly to the gas safety valve. The inlet has a manual shutoff valve so that the gas to the safety valve can be turned off (see Figure 6-13).

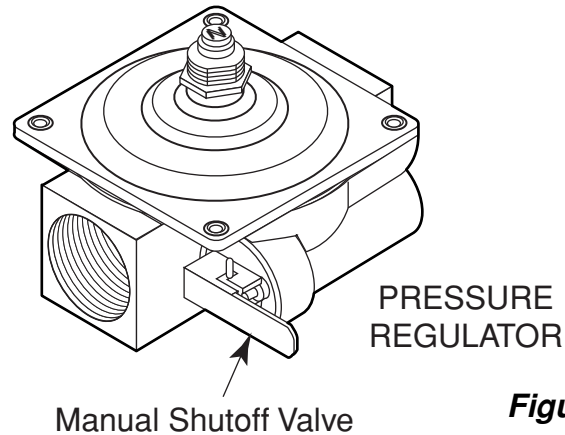


Figure 6-13

The common causes of pressure regulator failure are:

- a) Ruptured diaphragm.
- b) Broken or weak valve.
- c) Accumulated debris around the valve seat.
- d) Plugged vent.

The pressure regulator is normally replaced rather than serviced, since it has few replaceable or serviceable parts, and is a relatively inexpensive device.

Use a manometer, or a magnehelic gauge, to test the pressure regulator.

Natural Gas = 4" WCP

L.P. Gas = 11" WCP

If the reading is not within the range shown, the pressure regulator is defective and should be replaced.

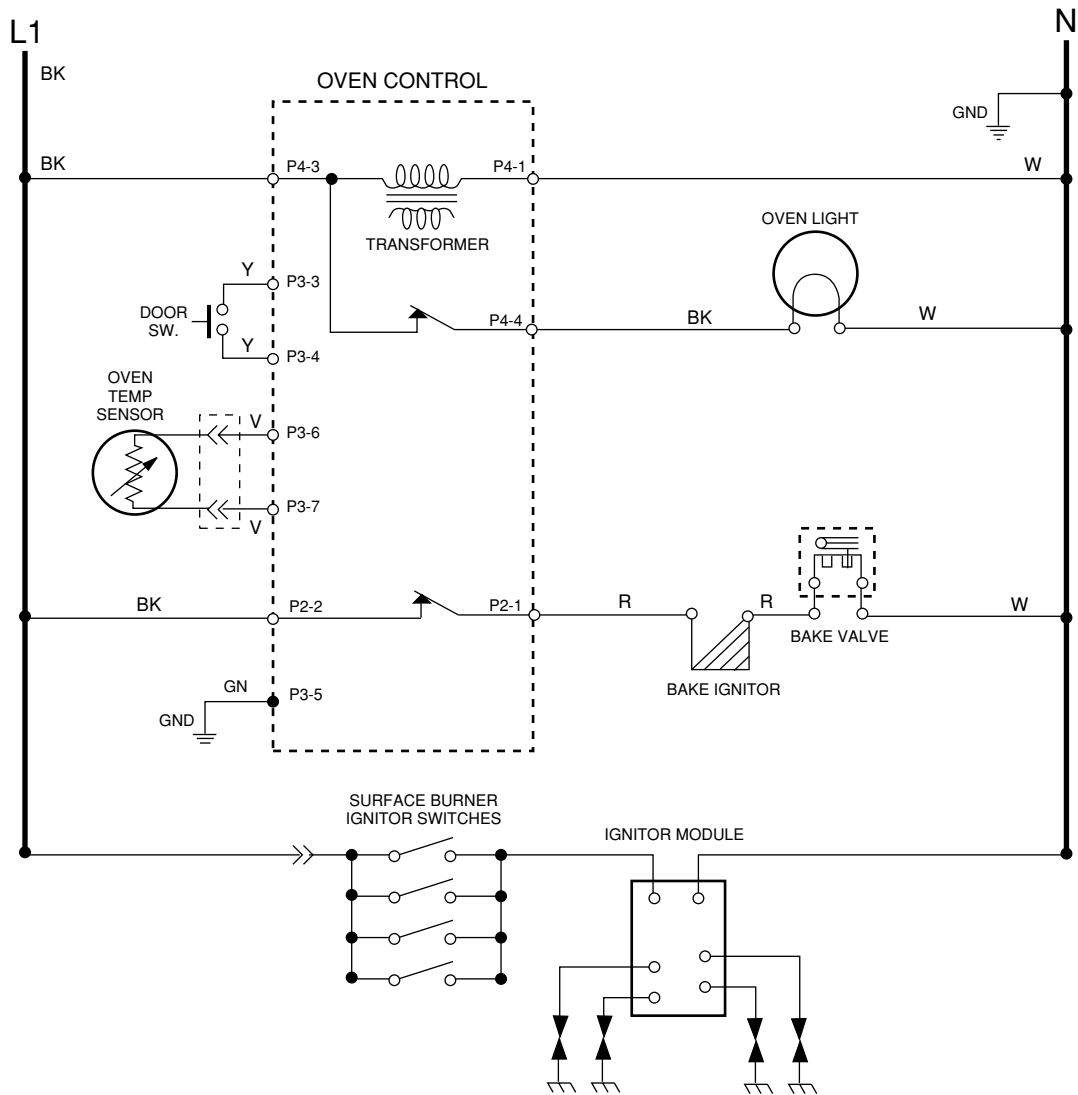
TROUBLESHOOTING CHART

PROBLEM	POSSIBLE CAUSE	SOLUTION
Gas odor.	Pilot light out.	Ventilate room, then relight pilot.
Gas odor with all pilots lit or with electronic ignition.	Burner control on slightly. Gas line leak.	Turn off burner controls. Turn off gas to range, ventilate room, call gas company.
Surface burner does not light.	Pilot light out. Burner pilot port hole blocked. Burner or flash tube out of position. No power to range (ranges with electronic igniters). Electronic igniter does not spark. Burner flame openings clogged. Too much air to burner. Not enough gas to burner.	Relight pilot. Clear burner portholes. Reposition burner or flash tube. Make sure range is plugged in. Also check for blown fuse or tripped circuit breaker. Inspect ignitor and ignitor module. Clean burner. Adjust air shutter. Check pressure regulator.
Surface burner pilot does not stay lit.	Pilot opening blocked. Pilot light set too low. Too much air to burner. Not enough gas to burner.	Clear pilot opening. Adjust pilot light. Adjust air shutter. Check pressure regulator.
Surface burner flame low or uneven.	Burner port openings clogged. Not enough air to burner. Not enough gas to burner.	Clean burner. Adjust air shutter. Check pressure regulator.
Surface burner flame too high, noisy, or blowing.	Too much air to burner. Too much gas to burner.	Adjust air shutter. Check pressure regulator.
Surface burner flame yellow or sooty.	Burner out of position. Not enough air to burner. Too much gas to burner.	Reposition burner. Adjust air shutter. Check pressure regulator.

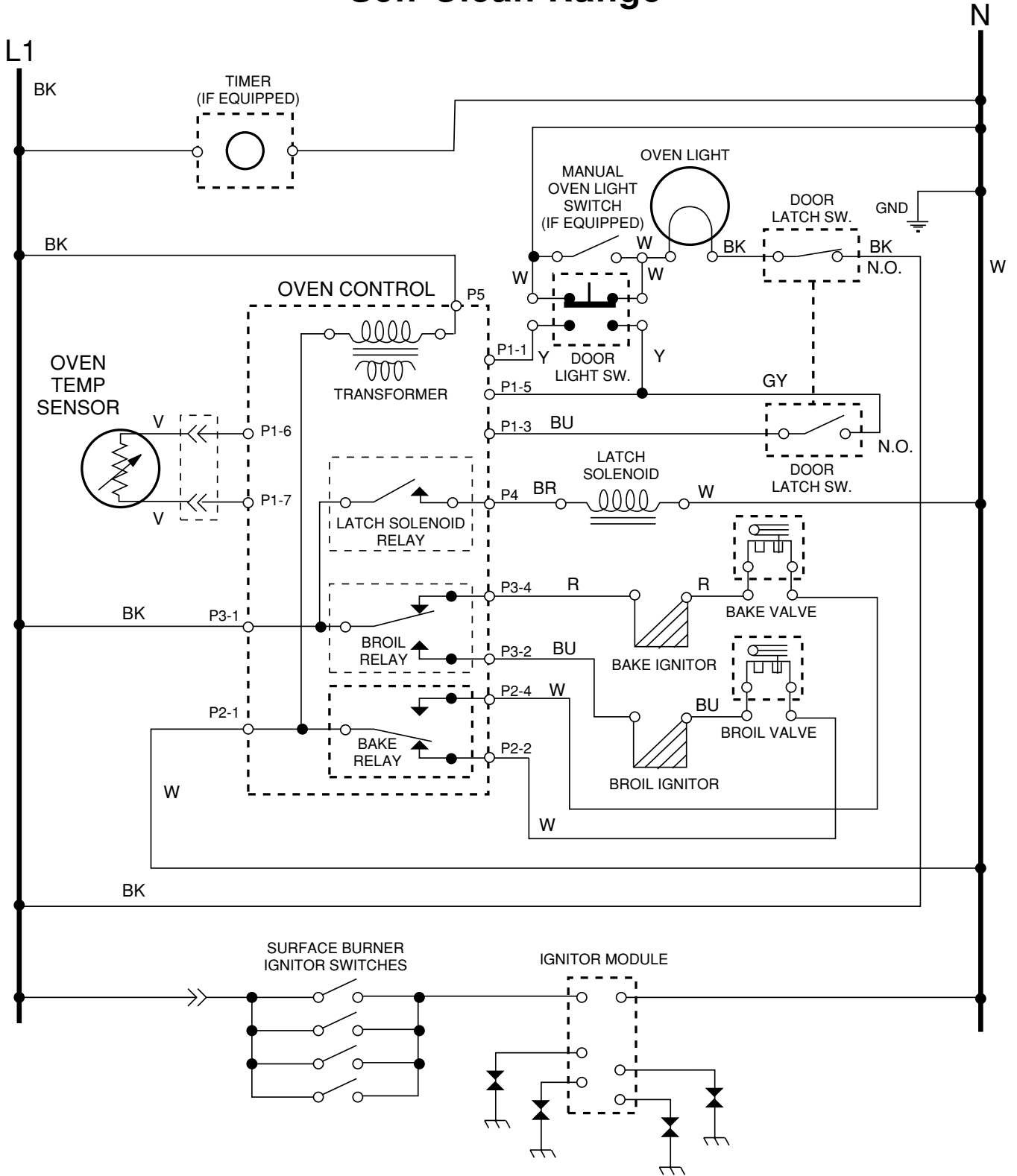
PROBLEM	POSSIBLE CAUSE	SOLUTION
Oven burner does not light.	Pilot light out. Pilot light set too low. Clock timer set improperly. No power to range (ranges with electronic igniters). Electronic igniter does not spark. Fuses blown (ranges with glow-bar igniter). Glow-bar igniter faulty. Thermostat, selector switch, or safety valve faulty.	Relight pilot. Adjust pilot light. Refer to "Use and Care manual" and reset timer. Make sure that range is plugged in. Also check for blown fuse or tripped circuit breaker. Inspect igniter and ignitor module. Test fuse. Check Glow-bar igniter. Check pressure regulator.
Oven burner pilot does not stay lit.	Pilot light set too low. Pilot opening blocked.	Adjust pilot light. Clear pilot opening.
Oven does not hold set temperature so that oven bakes unevenly.	Door misaligned or gasket faulty. Burner port openings clogged. Thermostat or capillary tube faulty.	Check door and oven gasket. Clear burner openings. Replace thermostat assembly.
Self-cleaning oven does not clean.	Control setting incorrect. Oven door not locked. Thermostat, selector switch, or door lock faulty. Door misaligned or gasket faulty. No power to range.	Check "Use and Care manual" and reset controls. Close and lock door. Check door lock assembly. Check door and oven gasket. Make sure that range is plugged in, check for blown fuse or tripped circuit breaker.

SCHEMATIC DIAGRAMS

Standard Range

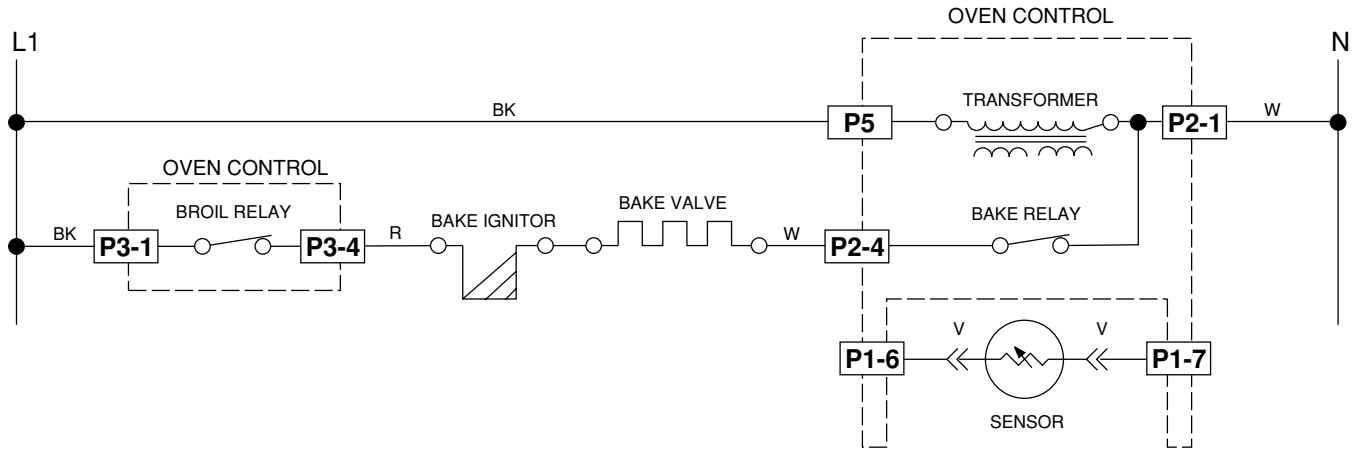


Self-Clean Range

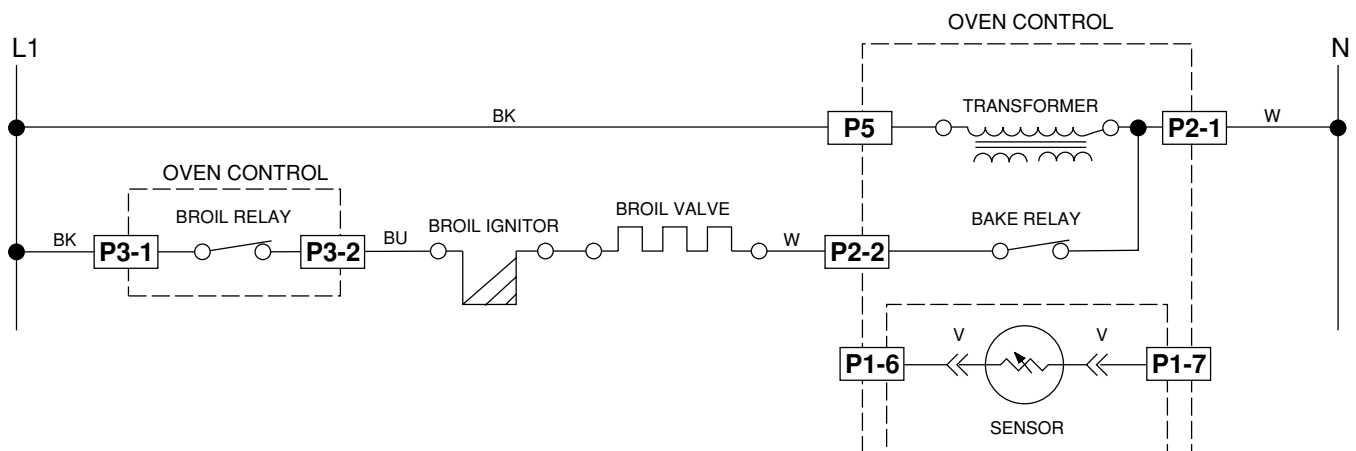


STRIP CIRCUITS

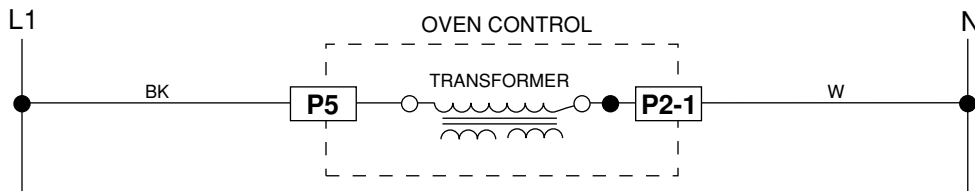
BAKE



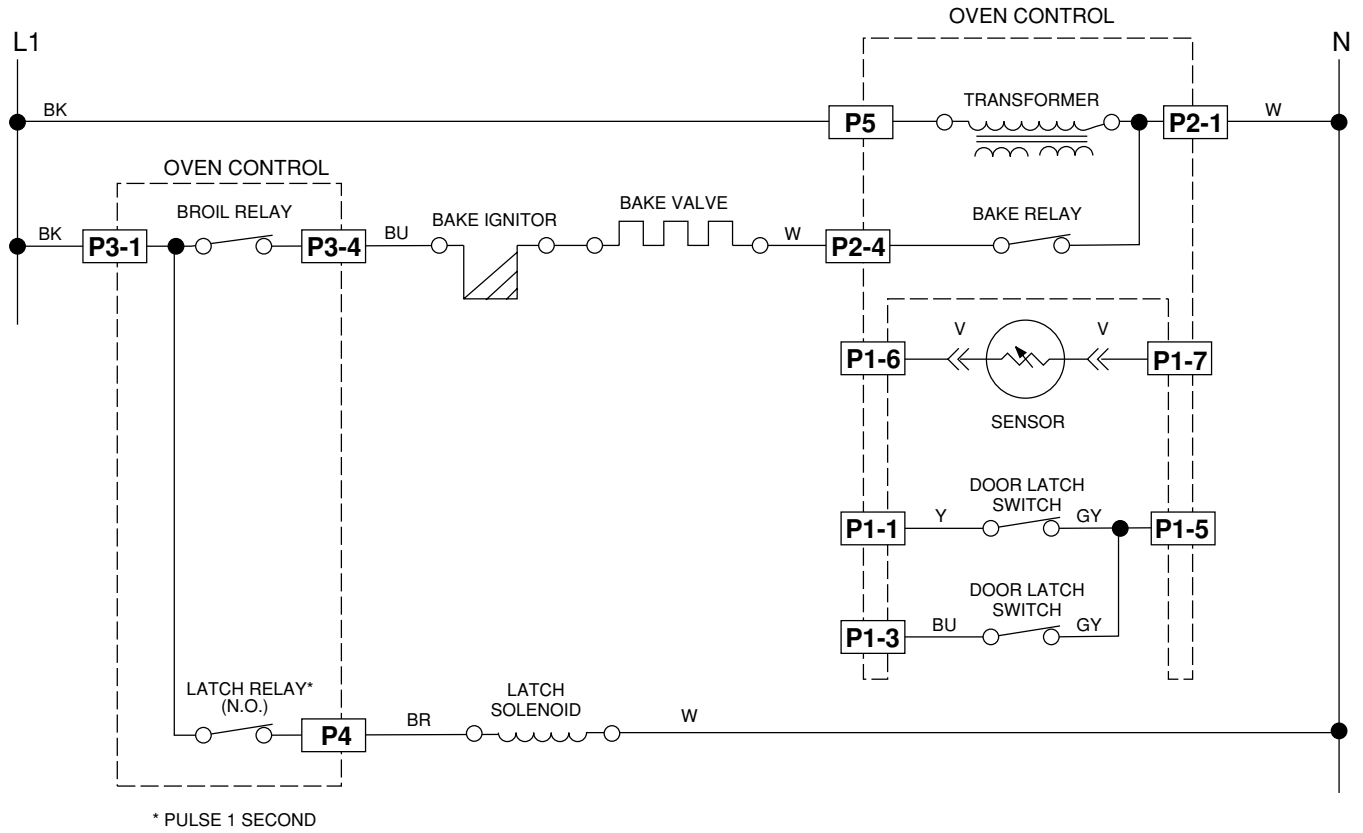
BROIL



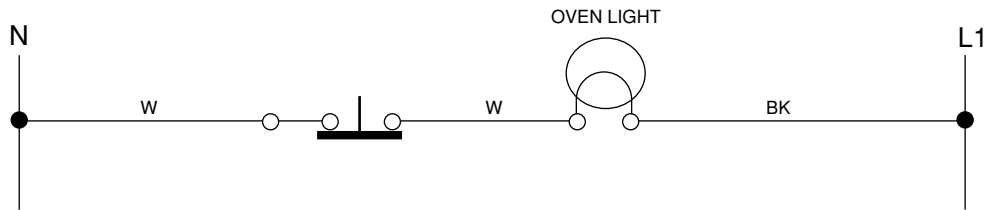
CONTROL BOARD POWER



SELF-CLEAN



OVEN LIGHT



— NOTES —